

# DESIGN ANALYSIS REPORT ASARCO EAST HELENA CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) PHASE 2 CELL

Prepared For:

ASARCO LLC P.O. Box 1230 East Helena, MT 59635





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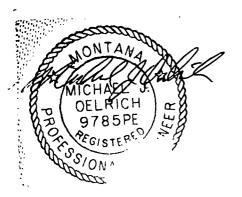
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## **TABLE OF CONTENTS**

LIST OF TABLES	iv
LIST OF FIGURES	iv
LIST OF APPENDICES	v
COMMENT/RESPONSES	vi
1.0 INTRODUCTION	1-1
2.0 PERFORMANCE STANDARDS	2-1
2.1 BOTTOM LINER SYSTEM	2-1
2.2 COVER SYSTEM	2-1
2.3 LEACHATE COLLECTION AND REMOVAL SYSTEM	2-2
2.4 LEAK DETECTION, COLLECTION, AND REMOVAL SYSTEM	2-3
2.5 SURFACE RUNON CONTROL SYSTEM	2-3
2.6 SURFACE RUNOFF CONTROL SYSTEM	2-3
2.7 CONTROL OF PARTICULATE MATTER	2-4
2.8 MONITORING, INSPECTION & CONSTRUCTION QUALITY	
CONTROL	2-4
2.9 CLOSURE CERTIFICATION AND POST CLOSURE CARE OF THE	
CAMU	2-4
2.10 OTHER DESIGN CRITERIA	2-4
3.0 CAMU DESIGN	3-1
3.1 SITE SELECTION	3-1
3.2 GEOTECHNICAL INVESTIGATION	3-4
3.2.1 Review of Existing Data	3-4
3.2.2 Results of Geotechnical Investigation	3-6
3.2.2.1 Depth of Sandy Loam Soil Layer	3-6
3.2.2.2 Maximum Proctor Density	3-7
3.2.2.3 Soil Classification	3-7
3.2.2.4 Hydraulic Conductivity	.3-8
3.3 SURFACE AND GROUNDWATER INVESTIGATIONS	.3-8
3.3.1 Surface Water	.3-8

3.3.2 Groundwater	3-9
3.4 SOIL MATERIALS	3-11
3.5 WASTE MATERIAL	3-12
3.6 SIZE AND CONFIGURATION	3-16
3.7 COMPONENT DESIGN	3-17
3.7.1 Liner Systems	3-17
3.7.1.1 Primary Flexible Membrane Liner (FML)	3-17
3.7.1.2 Secondary Composite Liner	3-22
3.7.1.3 Cap Composite Liner	3-22
3.7.2 Leachate Systems	3-22
3.7.2.1 Primary Leachate Collection and Removal (	(PLCR)
System	3-23
3.7.2.2 Leak Detection, Collection, and Removal (	LDCR)
System	3-26
3.7.3 Surface Water Collection and Removal (SWCR) System	3-27
3.7.4 Cover System	3-27
3.7.5 Groundwater Monitoring System	3-27
3.8 SEISMIC DESIGN	3-28
3.9 LINER COMPATABILITY	3-28
4.0 PLACEMENT OF WASTE SOILS, SEDIMENTS AND	
DEMOLITION DEBRIS IN CELL	4-1
5.0 TEMPORARY CLOSURE AND MONITORING	5-1
6.0 FINAL CLOSURE AND MONITORING	6-1
7.0 STANDARD PLANS AND SPECIFICATIONS	7-1
8.0 REFERENCES	8-1

# LIST OF TABLES

TABLE 3-1.	GEOTECHNICAL TEST PIT SAMPLE SUMMARY	3-8
TABLE 3-2.	SUMMARY OF CAMU MONITORING WELL CONSTRUCTION	ON 3-10
TABLE 3-3.	MAJOR DEMOLITION DEBRIS WASTE MATERIAL	
	QUANTITIES	3-13
TABLE 3-4.	CAMU PHYSICAL CONFIGURATION PARAMETERS	3-18
TABLE 3-5.	AVERAGE ANNUAL PRECIPITATION AND LEACHATE	
	VOLUMES FOR 80 YEARS	3-24
TABLE 3-6.	PEAK DAILY PRECIPITATION AND LEACHATE	
	VOLUMES FOR 80 YEARS	3-25
	LIST OF FIGURES	
FIGURE 3-1.	CAMU LOCATION MAP	3-2
FIGURE 3-2.	CAMU PHASE 2 CELL SITE TEST PIT, BORE HOLE AND	
	MONITORING WELL LOCATIONS	3-5
FIGURE 3-3.	SEALED DOUBLE RING INFILTROMETER TEST	
	RESULTS FROM MAY 2000	3-6
FIGURE 3-4.	CAMU PHASE 2 CELL HEIGHT VS. VOLUME	3-16
FIGURE 3-5.	TYPICAL CAMU PHASE 2 CELL CROSS-SECTIONS	3-19
FIGURE 3-6.	TYPICAL LANDFILL SECTION	3-20
FIGURE 3-7.	QUATERNARY FAULTS WITHIN THE VICINITY OF THE	
	PHASE 2 CELL	3-29

# LIST OF APPENDICES

APPENDIX A	SURFACE WATER HYDROLOGY
APPENDIX B	MONITORING WELL LOGS AND GROUNDWATER DATA
APPENDIX C	DESIGN ANALYSIS
APPENDIX D	SAMPLING AND MONITORING PLAN
APPENDIX E	OPERATION, MAINTENANCE AND POST-CLOSURE PLAN
APPENDIX F	CONSTRUCTION SCHEDULE
APPENDIX G	CONSTRUCTION QUALITY ASSURANCE PLAN
APPENDIX H	WASTE HAULING PLAN
APPENDIX I	PROJECT DRAWINGS
APPENDIX J	PROJECT SPECIFICATIONS
APPENDIX K	WASTE MATERIAL CATEGORIES AND QUANTITIES
APPENDIX L	THIRD PARTY INDEPENDENT OVERSIGHT

# **DESIGN REPORT**

# DESIGN ANALYSIS REPORT

#### ASARCO EAST HELENA

# CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) PHASE 2 CELL

#### 1.0 INTRODUCTION

This document and its associated appendices constitute the design analysis submittal for the proposed Corrective Action Management Unit (CAMU) Phase 2 Cell near the Asarco East Helena Plant ("the plant"). The plant is described in detail in other documents, particularly the Comprehensive Remedial Investigation/Feasibility Study (RI/FS, Hydrometrics, 1990), the Current Conditions Release Assessment (CCRA, Hydrometrics, 1998), and the RCRA Facility Investigation (ACI, 2003). The CAMU Phase 2 Cell for the East Helena Plant will contain plant site soil and demolition debris generated through the implementation of the Montana Consent Decree (CDV-2004-212), which expired December 31, 2006, and the RCRA Consent Decree (CV98-3-H-CCL). Asarco and the Montana Department of Environmental Quality have been negotiating a new Montana Administrative Order that will govern future cleaning and demolition projects at the East Helena site.

Although not required by CAMU regulations, the proposed CAMU Phase 2 Cell is designed to comply with the Resource Conservation and Recovery Act (RCRA), Subtitle C regulations and the Administrative Rules of Montana (ARM 17.50.506).

Tasks necessary to construct the CAMU Phase 2 Cell include:

- 1. Identification of Performance Standards
- 2. Site Selection
- 3. Geotechnical Investigation
- 4. Material Testing
- 5. Project Design

- 6. Project Construction
- 7. Waste Placement and
- 8. Closure and Monitoring.

Each of these tasks is discussed in this Design Submittal.

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#### 2.0 PERFORMANCE STANDARDS

The following performance standards for hazardous waste landfills, defined in 40 CFR 264 and ARM 17.50.506 were used for design of this project.

#### 2.1 BOTTOM LINER SYSTEM

#### (40 CFR § 264.301 (c)(1) and ARM 17.50.506)

- a. The liner system shall include two or more liners with a leachate collection removal system above and between them.
- b. The upper component of the bottom liner system shall consist of a flexible membrane with a minimum thickness of 35 mil, and will be designed and constructed to prevent migration of hazardous constituents into the bottom liner system.
- c. The lower component of the bottom liner system shall consist of a composite liner which shall include a minimum of three (3) feet of compacted soil with a maximum hydraulic conductivity of 1 x 10<sup>-7</sup> cm/sec overlain by a flexible membrane liner with a minimum thickness of 35 mil, designed and constructed to minimize the migration of hazardous constituents if a breach in the upper component were to occur.
- d. The liner system shall be designed and constructed to comply with 40 CFR §§ 264.301 (a)(1)(i), (ii), and (iii) to ensure that it is engineered to withstand the chemical and physical stresses it will be subjected to while containing the source area soils and demolition debris. The liner system shall be located, designed, constructed, and operated to be completely above the seasonal high water table.

#### 2.2 COVER SYSTEM

(40 CFR §§ 264.111, 264.310 AND 264.19)

The cover system shall:

- a. Minimize the need for further maintenance;
- b. Control, minimize or eliminate, to the extent necessary to protect human health and the environment, escape of source area soils and demolition debris, hazardous

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- constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere;
- c. Provide long-term minimization of migration of liquids through the closed CAMU;
- d. Function with minimum maintenance;
- e. Promote drainage and minimize erosion or abrasion of the cover;
- f. Accommodate settling and subsidence so that the cover's integrity is maintained; and
- g. Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.

#### 2.3 LEACHATE COLLECTION AND REMOVAL SYSTEM

(40 CFR §§ 264.301 (c)(2), (c)(3)), and ARM 17.50.506(6)(b).

- a. The leachate collection and removal system immediately above the top liner must be designed, constructed, operated, and maintained to collect and remove leachate from the CAMU Phase 2 Cell. It shall be designed and operated to ensure that leachate depth over the liner is minimized to the extent practicable, and does not exceed one (1) foot.
- b. This system shall be designed and constructed to comply with 40 CFR §§ 264.301 (c)(3)(iii) and (iv) to ensure that it is engineered to withstand the chemical and physical stresses to which it will be subjected and to minimize clogging.
- c. This system shall be constructed with a bottom slope of two percent or more.
- d. This system shall be constructed of either a granular drainage material with a hydraulic conductivity of 1x10<sup>-2</sup> cm/sec or more and with a minimum thickness of 12 inches, or of a synthetic geocomposite material with a transmissivity of 3x10<sup>-5</sup>m<sup>2</sup>/sec or more.
- e. The leachate collection and removal system shall have a sump to collect the leachate from the drainage layer and a removal system of sufficient size to prevent liquids from backing up into the drainage layer.

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# 2.4 LEAK DETECTION, COLLECTION, AND REMOVAL SYSTEM (40 CFR §§ 264.301 (c)(3) AND (c)(4), 264.302, AND 264.304)

- a. The leak detection, collection and removal system between the liners shall be constructed with a bottom slope of two percent or more of granular drainage materials with a hydraulic conductivity of 1 x 10<sup>-2</sup> cm/sec and a thickness of 12 inches or more, or with synthetic or geocomposite drainage materials with a transmissivity of 3 x 10<sup>-5</sup> m²/sec or more and it shall be constructed with sumps and liquid removal methods that shall be operated to minimize the head on the bottom liner system in accordance with 40 CFR §§ 264.301 (c)(3)(v) and 264.301 (c)(4). An action leakage rate and response action plan will be established for the CAMU in accordance with 40 CFR §§ 264.302 and 264.304 to address design flow rates in the leak detection system which will result in a head greater than one foot on the bottom liner system.
- b. The leak detection, collection and removal system between the liners shall be designed and constructed to comply with 40 CFR §§ 264.301 (c)(3)(iii) and (iv) to ensure that it is engineered to withstand the chemical and physical stresses to which it will be subjected and to minimize clogging.

#### 2.5 SURFACE RUNON CONTROL SYSTEM

(40 CFR §§ 264.301 (g) AND (i))

The run-on control system shall be capable of preventing flow onto the active portion of the CAMU Phase 2 Cell during peak discharge from a 24-hour, 25-year storm. Collection and holding facilities that are associated with this system must be emptied, or otherwise managed expeditiously after storms, to maintain design capacity of the system.

#### 2.6 SURFACE RUNOFF CONTROL SYSTEM

(40 CFR §§ 264.301 (b) AND (i))

The run-off management system shall collect and control at least the water volume resulting from a 24-hour, 25-year storm. Collection and holding facilities which are associated with this system must be emptied expeditiously, or otherwise managed after storms to maintain design capacity of the system.

# 2.7 CONTROL OF PARTICULATE MATTER (40 CFR § 264.301 (j))

The CAMU shall be operated to control wind dispersal of waste soils, sediments, and demolition debris placed in it, consistent with the requirements of 40 CFR § 264.301(j).

# 2.8 MONITORING, INSPECTION & CONSTRUCTION QUALITY CONTROL (40 CFR §§ 264.19 AND 264.303)

A Construction Quality Control (CQA) program shall be established for the CAMU to ensure that the constructed unit meets or exceeds all design criteria and specifications in accordance with 40 CFR §§ 264.19 and 264.303. A copy of the Construction Quality Assurance Plan is in Appendix G. The CAMU Phase 2 Cell systems must be inspected during operation and the leak detection system inspected after closure. Inspection of the CAMU Phase 2 Cell during operations will be in accordance with 40 CFR §264.303, and 264 Subpart F requirements will be used for establishment of a groundwater monitoring program for releases after closure.

# 2.9 CLOSURE CERTIFICATION AND POST CLOSURE CARE OF THE CAMU (40 CFR §§ 264.310, 264.115 THROUGH .120)

The closure certification, monitoring, inspection, operation, maintenance, and record keeping requirements of 40 CFR §§ 264.310, 264.115-120, 264 Subpart H, and 264 Subpart G must be adhered to after closure of the CAMU. The post-closure period of the CAMU shall be indefinite.

#### 2.10 OTHER DESIGN CRITERIA

Other design criteria are listed by reference in Section 3.0 CAMU Design.

#### 3.0 CAMU DESIGN

This design analysis addresses the CAMU Phase 2 Cell that will be constructed in 2007 to contain demolition debris and waste soils from current remedial cleanup activities. The location of the CAMU Phase 2 Cell is shown on Figure 3-1.

Most of the elements of CAMU Phase 2 Cell design were addressed in the CAMU Phase 1 Cell Design Report (Hydrometrics, 2000) approved by EPA in July 2000. Additional information addressed in this Design Analysis Report includes:

- Location of the CAMU Phase 2 Cell.
- Borehole and Test pit excavation and soil testing for CAMU Phase 2 Cell compacted clay liner construction (Section 3.2).
- Construction of three additional wells to better define site stratigraphy and groundwater flow conditions (Section 3.3).
- Changes to design of the Leachate Collection and Leak Detection Removal Designs.

#### 3.1 SITE SELECTION

An examination of site soils adjacent to the CAMU Phase 1 Cell was completed in September 2006, and indicates that the area immediately south/southeast of the CAMU Phase 1 Cell is well suited as the site for the CAMU Phase 2 Cell. Further discussion of the CAMU Phase 2 Cell site location is found in the CAMU Phase 2 Cell Geotechnical Investigation (Hydrometrics, 2006). As required by either 40 CFR 264.18 or ARM 17.50.505, the proposed site, shown on Figure 3-1, has **no**:

- Wetlands
- Floodplains
- Faults
- Instability
- Underlying rock fractures or fissures



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- Insufficient land area
- Insufficient public access
- Groundwater or surface water pollution potential
- Public water supplies
- Hydraulic connections to springs
- Airport that has jet aircraft within 10,000 feet or
- Other airports within 5,000 feet.

#### In addition, the site is:

- At least 200 feet from adjacent property lines.
- At least 500 feet from public drinking water sources, residences, schools, hospitals, and centers of community activity.
- Within a seismic impact zone. However, pursuant to 40 CFR 270.14(b)(11) it is over 3,000 feet from a fault that has had displacement in Holocene time.
- Without subsidence areas.
- Not in a sole-source aquifer recharge area.
- Without endangered species habitat.
- Not in designated state and federal wilderness, parks and preserves.
- Not zoned for activities other than industrial use or agriculture.
- Without historic or archaeological significance.
- Vertically separated from the underground aquifer and without springs.
- Distant from groundwater discharge to a water supply well or to surface water.
- In simple (homogeneous) hydrogeologic stratigraphy.
- In soils that are nearly impermeable or at least in a location which does not intercept or directly overlie an appreciable thickness of permeable soils.

When combined with proper CAMU Phase 2 Cell design and construction, this site will prevent the migration of wastes into the surrounding water and soil.

#### 3.2 GEOTECHNICAL INVESTIGATION

Geotechnical evaluations were conducted during August and September 2006 to collect information for site evaluation and design. Twenty-eight (28) boreholes (TP-A1 through TP-G2) and seven (7) test pits (TP-1 through TP-7), shown on Figure 3-2, were drilled or excavated in the area of the CAMU Phase 2 Cell to collect geotechnical information. In addition, three groundwater monitoring wells (MW-8 through MW-10) were installed in the areas surrounding the CAMU Phase 2 Cell to provide additional stratigraphic information and to provide baseline and post construction groundwater quality and hydrology information. Details of the geotechnical investigation, including borehole and test pit logs, are documented in the CAMU Phase 2 Cell Geotechnical Investigation (Hydrometrics, 2006).

### 3.2.1 Review of Existing Data

Evaluation of the areal geology and hydrogeology has been addressed previously in the Remedial Investigation Report for the adjacent Asarco East Helena Lead Smelter (Hydrometrics, 1990) and the CAMU Phase 1 Cell Design Report (Hydrometrics, 2000). As described in this report, a test pad was constructed and a 6-foot sealed double-ring infiltrometer (SDRI) was installed in May 2000 in order to accurately measure the infiltration rate of a compacted clay liner (CCL) constructed from local borrow soil. The test pad was constructed using the field equipment and procedures that are similar to what will likely be used for CAMU Phase 2 Cell construction. As shown in Figure 3-3, the SDRI test results showed that an effective permeability less than 10<sup>-7</sup> centimeters-per-second can be achieved using site borrow soils.

When combined with the list of desirable site characteristics, compiled in Section 3.1 of this report, these infiltrometer results confirm that site soils and geology will minimize the migration of any hazardous materials from the CAMU Phase 2 Cell and are conducive to construction of a reliable CAMU Phase 2 Cell.

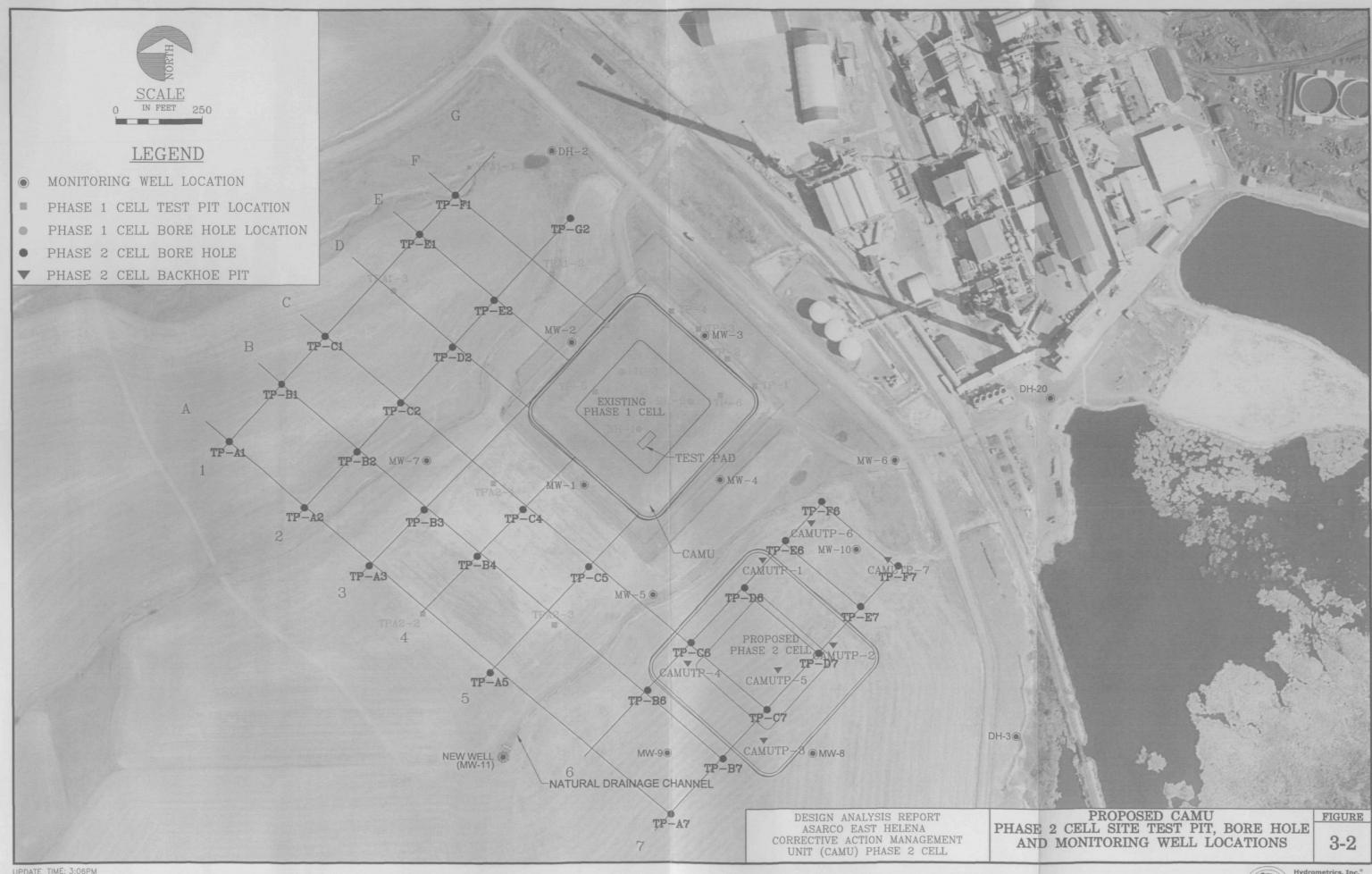
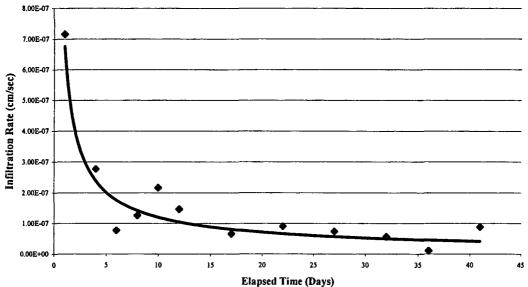


FIGURE 3-3. SEALED DOUBLE RING INFILTROMETER TEST
RESULTS FROM MAY 2000



#### 3.2.2 Results of Geotechnical Investigation

Results from the 2006 geotechnical investigation were documented in the CAMU Phase 2 Cell Geotechnical Investigation (Hydrometrics, 2006) and are summarized in the sections that follow. As explained in this report, the soil conditions encountered during this investigation resulted in a shift of the proposed CAMU Phase 2 Cell location to the area adjacent to and east of the existing CAMU Phase 1 Cell.

#### 3.2.2.1 Depth of Sandy Loam Soil Layer

At the proposed site of the CAMU Phase 2 Cell, the depth of the clayey loam varied from 15 to 20 feet. At that depth, the loam soil transitions over a 2 to 5 foot interval to a poorly graded gravel, cobble, and boulder soil layer. Depths of loam are very similar to those encountered during the site investigation for the CAMU Phase 1 Cell.

The intent of siting the CAMU Phase 2 Cell in this particular soil unit is to use the loam soil as an impermeable foundation and as a construction material for the cell's compacted clay liner. The depth and quality of the clayey loam soil layer impacts the feasibility of

constructing the clay liner from site soil and controls the allowable depth of excavation for the CAMU cell.

#### 3.2.2.2 Maximum Proctor Density

The insitu density of the site loams ranges from 85 to 96 pounds-per-cubic-foot (pcf). Maximum compacted densities were measured to be approximately 100 to 112 pcf. Therefore, compaction of site soil can be expected to increase the average insitu density of the soil by almost 20 percent. These densities are similar to those measured during the CAMU Phase 1 Cell investigation and suggest that compaction of the site soils will result in a significant increase in density and a corresponding decrease in permeability.

#### 3.2.2.3 Soil Classification

Soil gradation and plasticity were measured from bulk test pit samples and were used to classify site soils and to determine their suitability for construction of the compacted clay liner. All samples from the CAMU Phase 2 Cell site were classified as fine-grained soils, and except for one test pit that classified as low plasticity silt (ML), samples from test pits were classified as low plasticity clay (CL). As discussed in the CAMU Phase 2 Cell Geotechnical Investigation (Hydrometrics, 2006), site soils were generally found to be finer and more plastic than those tested in the CAMU Phase 1 Cell investigation and are suitable for use in construction of the compacted clay liner.

The soil classification is used to verify the appropriateness of many of the soil properties used for design. A CL-ML soil is expected to have a unit weight in the range of 90 pcf when loose to 120 pcf when compacted. It is expected to have an angle of internal friction ( $\phi$ ) of 20° to 30° depending on the amount of sand and the density of the material. Saturated cohesion for this material is likely to range from 190 to 460 psf depending upon how much of the fine material is silt and how much is clay. This information is valuable for slope stability and settlement calculations, as well as many other design decisions.

### 3.2.2.4 Hydraulic Conductivity

To determine the effect of surcharge on permeability, falling head parameter tests were conducted on three test pit samples. Appendix A contains the laboratory results that are summarized in Table 3-1. With a 22 pounds-per-square-inch (psi) surcharge, hydraulic conductivity for the site clayey soils ranged from 3 to 9.7 x 10<sup>7</sup>cm/sec. Although these results are relatively consistent with those obtained for the CAMU Phase 1 Cell and indicate that hydraulic conductivity is reduced by one to two orders of magnitude under a surcharge pressure, the EPA required hydraulic conductivity of 10-7 cm/sec was not achieved by any of the samples. Therefore, the addition of a GCL to the secondary liner will be required by EPA in order to meet this performance standard.

TABLE 3-1. GEOTECHNICAL TEST PIT SAMPLE SUMMARY

CAMU Phase 2 Cell Sample No.	Soil Classification	% Fines	PI	Compaction Test Data (ASTM D 698)	Hydraulic <sup>1</sup> Conductivity (cm/sec)	Hydraulic <sup>2</sup> Conductivity (cm/sec)
TP-2	CL	57.9	8	Max. DD = 108 pcf OM = 17%	k= 1.8 x 10 <sup>-6</sup>	k= 9.3 x 10 <sup>-7</sup>
TP-3	CL	70.9	18	Max. DD = 100.5 pcf OM = 19.2%	k= 1.2 x 10 <sup>-5</sup>	k= 3.0 x 10 <sup>-7</sup>
TP-7	CL	61.9	8	Max. DD = 105 pcf OM = 18.5%	k= 2.0 x 10 <sup>-6</sup>	k= 9.7 x 10 <sup>-7</sup>

<sup>&</sup>lt;sup>1</sup>Hydraulic conductivity measured after initial saturation with no effective stress (Hydrometrics, 2006).

#### 3.3 SURFACE AND GROUNDWATER INVESTIGATIONS

The list of desirable site criteria compiled in Section 3.1 suggests that site surface water and groundwater should be isolated to the extent possible from the CAMU Phase 2 Cell. Monitoring wells 8, 9, and 10 indicate the water table is present between 29 and 57 feet bgs and will be separated from the bottom of the CAMU Phase 2 Cell by 20 feet of low permeability sandy loam soil as described in Section 3.2.

#### 3.3.1 Surface Water

Prickly Pear Creek flows along the east edge of Asarco's property boundary, but is over 2,000 feet from the CAMU Phase 2 Cell site. The floodplain boundary for Prickly Pear

<sup>&</sup>lt;sup>2</sup>Hydraulic conductivity measured after increase of effective stress to 22 psi and resulting consolidation (Hydrometrics, 2006).

Creek coincides with the edge of Upper Lake, which is over 500 feet from the site. As shown in Figure 3-1, a small drainage gully to the northwest of the site collects runoff and empties into a storm water ditch that bounds the northeast side of the site. This ditch directs storm water to Upper Lake.

The CAMU Phase 2 Cell site lies within a drainage area of 23.7 acres with an average slope of about 4 percent and a longest flow path of 1437 feet. A 25-year, 24-hour precipitation event at the site is expected to produce 2.3 inches of rain and a peak flow of 4 cubic-feet-persecond (cfs) that needs to be diverted around the site.

The cap of the CAMU Phase 2 Cell occupies approximately 5.1 acres with an average slope of about 13 percent and a longest flow path of 425 feet. A 25-year, 24-hour precipitation of 2.3 inches is expected to produce a peak runoff flow of 4 cfs and a total runoff volume of 1.08 acre-feet that will need to be controlled by Best Management Practices (BMP) until the cap cover vegetation is established. Peak flows and runoff volumes were calculated using software (EFH 2) from the Natural Resource Conservation Service's Engineering Field Handbook. Appendix A contains documentation of the site surface water investigation and calculations of flows.

#### 3.3.2 Groundwater

The groundwater regime and hydrogeology of the CAMU area have been interpreted from stratigraphic and water level data from groundwater monitoring wells and from hydrogeologic data collected during the plant site remedial investigation and subsequent long-term monitoring. In addition to the seven groundwater monitoring wells that were constructed adjacent to the CAMU Phase 1 Cell site, three additional groundwater monitoring wells were constructed outside the footprint of the CAMU Phase 2 Cell and centered approximately on the southeast (MW-8), southwest (MW-9), and northeast (MW-10) sides. Well depths were 70 feet. All CAMU monitoring wells were located horizontally and vertically for subsequent interpretation of the groundwater potentiometric surface and groundwater flow direction. Table 3-2 shows well completion data for the CAMU Phase 2 Cell monitoring wells. Figure 3-2 shows the location of these wells with respect to the

TABLE 3-2. SUMMARY OF CAMU MONITORING WELL CONSTRUCTION

Well Number	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10
Screened Interval Lithology	ash/tuff									
Ground Surface Elevation (ft) <sup>1</sup>	3947.78	3940.57	3935.84	3941.08	3949.62	3931.92	3957.69	3952.37	3958.92	3940.26
Measuring Point  Elevation (ft) <sup>1</sup>	3949.43	3942.36	3937.38	3943.52	3952.52	3934.54	3959.99	3954.97	3961.72	3942.59
Total Depth Drilled (ft bgs) <sup>2</sup>	68	66	50	72	71	40	60	70	70	70
Screened Interval (ft bgs) <sup>2</sup>	58-68	56-66	38.5-48	54-64	55-65	30-40	44-57	45-65	50-70	42-62
Date Installed	06/26/1997	06/27/1997	06/30/1997	05/08/2000	05/11/2000	05/13/2000	05/16/2000	09/26/2006	09/26/2006	09/27/2006

<sup>&</sup>lt;sup>1</sup> Mean Sea Level <sup>2</sup> bgs - Below Ground Surface

proposed CAMU Phase 2 Cell perimeter. Appendix B provides lithologic and construction logs for the wells.

In general, the stratigraphy encountered at the monitoring wells sites in the vicinity of the CAMU consists of silty clay (CL) interbedded with clayey silt (ML) from ground surface to 25 feet below ground surface (bgs). A 10 to 20 foot thick horizon of sandy gravel is present between 25 and 35 feet bgs. An ash/tuff unit underlies the sandy gravel unit in all CAMU monitoring wells. The ash/tuff unit in the CAMU monitoring wells was encountered to depths up to 72 feet bgs. None of the monitoring wells penetrate through the ash/tuff unit. Exhibit 1 in Appendix B contains geologic cross sections of the site created from the monitoring well logs.

Groundwater levels were measured in December 2006 to construct a groundwater potentiometric map for the CAMU area. A monitoring well network, consisting of over 40 monitoring wells at the Asarco plant site, was also evaluated to help define the groundwater potentiometric surface near the CAMU area.

Water levels ranged from approximately 36 feet bgs at well MW-10 to 55 feet bgs at MW-9. Previous investigations at the plant site (Hydrometrics, 1990) and in the Helena Valley (USGS, 1992) show that regional groundwater movement in the East Helena area is northward. In Appendix B are two potentiometric maps from 2004 and 2006 showing groundwater flow directions within the CAMU area.

#### 3.4 SOIL MATERIALS

Earth fill, in sufficient quantities required for this project, exists within the East Helena area. Earth fill includes random fill, engineered fill, drainage gravel, and cover soil. All earth fill will be obtained from the project site except for drainage gravel, which is readily available from local sand and gravel suppliers. Test results for gradation and permeability of material from the local sources will be required as part of construction specification performance standards.

The compacted clay liners are key components of the CAMU liner and cover systems and require careful material control. Material for construction of the liners is available from excavated materials on-site. As explained in Section 3.2, results from the geotechnical investigation indicate that site soil is suitable for use in construction of the compacted clay liner for the CAMU Phase 2 Cell. During site preparation and excavation, the sandier (low clay content) site soil will be segregated from the more clayey soil, which will be tested to confirm suitable gradation and plasticity before being used for construction of the CCL.

Testing will be conducted during construction to verify that soils excavated for use in construction of the compacted clay liner are suitable. EPA guidance (EPA, 1989) explains that to produce a protective CCL, the soil used for construction of the soil liner should have certain characteristics. First, it should have at least 20 percent fines. Second, it should have a plasticity index greater than 10. Third, it should be composed of no more than 10 percent gravel-size particles, and fourth, it should contain no soil particles larger than 1 or 2 inches in diameter. As discussed in the CAMU Phase 2 Cell Geotechnical Investigation (Hydrometrics, 2006), it should be possible to meet these standards with site soil if used selectively. First, site soil has between 58 and 71 percent fines. The average fraction of fines for the four samples tested is 65 percent, which is well above the standard of 20 percent. Second, the Plasticity Index (PI) for site soil ranges between 8 and 18 percent, with an average of 12 percent, which is greater than the standard of 10 percent contained in EPA guidance. Third, site soils range from less than 1 to 8 percent gravel. The average gravel fraction is much less than the standard of 10 percent required to be indicative of soil suitable for construction of a compacted clay liner. Finally, material specifications for the compacted clay liner have been written to prevent soil particles greater than 1 or 2 inches from being used to construct the liner, as suggested by EPA design guidance.

#### 3.5 WASTE MATERIAL

Waste material that is to be placed in the CAMU will consist of demolition debris and waste soils from within the plant area and generated from RCRA corrective action projects. The major demolition debris waste material source areas and quantities are listed in Table 3-3.

3-12

# TABLE 3-3. MAJOR DEMOLITION DEBRIS WASTE MATERIAL QUANTITIES

		Cubic Yds
2006		
On Site Stored Demolition Material		14,000
	2006 Total	14,000
2007		
Blast baghouse area (exc. Stack)		4,120
Acid plant contact section (exc. Stack)		2,100
Monier Flue		1,650
Blast furnace flue		6,250
Stacks (Oak Park Chimney)		6,890
Garage, Gas meter house & North end of Highline to	restle	100
Dross plant baghouse		130
Sample mill & old crushing mill		2,100
Ore yard & Thawhouse		980
Spray dryer building		250
Main Office		545
New & old breaking floors, Sinter stocking building	& Charge floor	1,370
Carpenter shop and Pump house & Blast heat exchange	nger	130
Blast furnace building		140
Blast office, lunchroom & loco crane shed		160
Direct Smelt building		400
Machine shop & Blacksmith shop		180
Cement & Dust silos		50
Power house		100
South end of High line trestle		25
Paint shop & Motor storage shed		250
High lead shop, Refractory, and Meeting room		423
Powerhouse		100
	2007 Total	28,443

TABLE 3-3. MAJOR DEMOLITION DEBRIS WASTE MATERIAL QUANTITIES (continued)

	Cubic Yds
2008	
Shop lunchroom, Zinc Plant pumphouse & Truck scale	75
Storage Trailer, Contractor change & lunchroom	545
Records Storage, Warehouse annex, & belly yard rail	540
Slag handling pad, Warehouse oil & Oxygen/acetyl storage	635
Ore Storage Building (grade level)	12,000
Warehouse, Environmental office	500
Acid tanks, Coverall Bldgs, Truck scale & High grade	500
Rail road ties & timbers (slag dump & belly yard)	1,000
Slag dump cleanup	2,000
Excavation for Plant Cap	2,000
Remediation of property for Chemet	5,000
Lake Shore Shed	10
Asarco On-Site Sanitary Treatment	10
Zinc Plant Loco Shop	10
2008 Total	24,825
2009	
Bathhouse, Medical office, & Thornock tank	1,000
HDS water treatment, Car wash. Neutralization building & acid sump	1,000
Northwestern Energy substation	50
Rodeo tank & storm water sumps	50
2009 Total	2,100
TOTAL	69,368

See Appendix K for source document.

Some demolition debris may contain asbestos that will be managed in accordance with all applicable National Emission Standards for Hazardous Air Pollutants (NESHAP), OSHA, MSHA, and DOT regulations. All asbestos containing materials will be properly containerized or thoroughly wetted and labeled before being transported to the CAMU Phase 2 Cell. All asbestos containing material will be placed in the SW corner of the cell as designated on the design drawings, and covered with a minimum of 6-inches of non-asbestos containing material within 24-hours of placement in the cell. Records will be kept identifying when and where asbestos containing materials were placed in the CAMU Phase 2 Cell. Care will be taken when placing additional waste material above the asbestos containing materials as to not disturb containerized materials or expose them to the air.

In order to ensure that the CAMU Phase 2 Cell design is compatible with the waste material that is to be placed in it, the chemical compatibility and gas generating potential of demolition debris was investigated and examined.

HDPE geomembranes have adequate chemical resistance to endure and retain their integrity well beyond other factors that will cause a liner to fail. Although not anticipated, if the leachates contain unusually high concentrations of oxidizing acids, chlorinated solvents, or detergents that remain constantly on the liner for considerable times, environmental stress cracking may occur. Waste materials at the East Helena Plant that could subject the cell liners to an extreme pH will be identified to the demolition contractor, who will be required to either neutralize these materials or to blend them with neutral material and place them in the upper portion of the cell.

The primary source of gas generation within most landfills is typically the decomposition of organic materials (primarily household waste such as paper and lawn waste) and the subsequent release of methane gas. Average municipal (sanitary) landfill refuse contains 55 percent woody materials (paper, grass, leaves, etc.) by weight and 28 percent organic carbon (EPA, 1979). In comparison, the smelter waste materials consist largely of smelter demolition debris and granular fill materials that contain only small quantities of organic materials. However, there is a small quantity of wood, such as treated timbers and railroad

ties, that will be placed in the cell. Consequently, gas from these materials is expected to be generated and a gas extraction system was included in the design.

#### 3.6 SIZE AND CONFIGURATION

Preliminary estimates for the construction indicate that approximately 70,000 cubic yards of demolition debris and waste material will be removed from the plant site and placed in the CAMU Phase 2 Cell. The sources and estimated quantities of waste material for the CAMU Phase 2 Cell are shown in Table 3-3.

The preliminary configuration of the CAMU Phase 2 Cell area includes 3:1 side slopes on the inside of the cell and 5:1 side slopes on the cap. A stability analysis of these slopes is contained in Appendix C. This configuration provides a potential storage volume in the cell of approximately 70,000 cubic yards, which is adequate capacity for placement of the wastes listed in Table 3-3, however, additional capacity can be obtained by raising the height of the cell while maintaining the identical footprint. Figure 3-4 shows the effect on cell volume of varying the cell height.

120000
80000
Proposed CAMU Phase 2 Cell
40000
5 7 9 11 13 15 17 19 21 23 25
Cell Height (feet)

FIGURE 3-4. CAMU PHASE 2 CELL HEIGHT VS. VOLUME

The footprint for the CAMU Phase 2 Cell covers approximately five acres. Table 3-4 lists the configuration parameters. The site plan is shown on Figure 3-1.

The cross sections for the cell are shown on Figure 3-5. The proposed bottom of the cell excavation is approximately 8 feet below ground surface and the CAMU cap is approximately 17 feet above the ground surface.

#### 3.7 COMPONENT DESIGN

The CAMU cell is designed and constructed to meet the Performance Standards stated in 40 CFR 264 subpart N – Landfills and ARM 17.50.506. General specifications are described below. In accordance with EPA and Montana DEQ guidance, the CAMU Phase 2 Cell has been designed and constructed with multiple barriers encapsulating the waste.

#### 3.7.1 Liner Systems

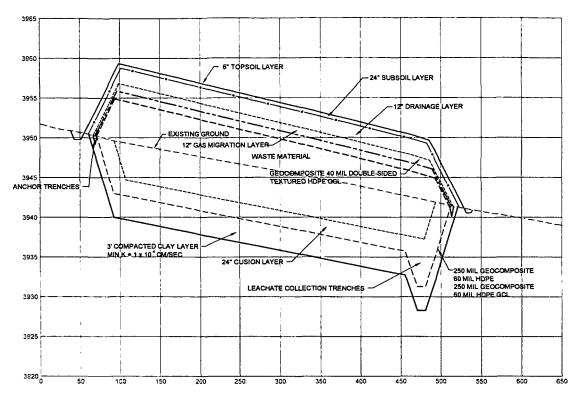
The typical CAMU Phase 2 Cell section, including the primary, secondary and cap liner systems; is shown on Figure 3-6. The primary liner underlies the waste material, but is separated from the waste by a geocomposite. The secondary liner system underlies the primary liner and is separated from it by another geocomposite layer. Unlike the primary liner, the secondary liner system is a composite consisting of a 3-foot thick layer of compacted clayey soil overlain by a geosynthetic clay liner and a flexible membrane. The cap liner system overlies the waste material and contains a composite liner consisting of a geosynthetic clay overlain by a flexible membrane. The cell liner systems utilize a 60-mil double-sided textured HDPE geomembrane for their flexible membrane component, while the cap liner uses a 40-mil double-sided textured HDPE geomembrane.

#### 3.7.1.1 Primary Flexible Membrane Liner (FML)

The primary FML consists of a high density polyethylene (HDPE) geomembrane that is designed to contain any leachate that is produced from the waste material and to withstand the stresses applied to it from the weight of the waste material and cap, from construction of the cell, and from the settlement of underlying soils.

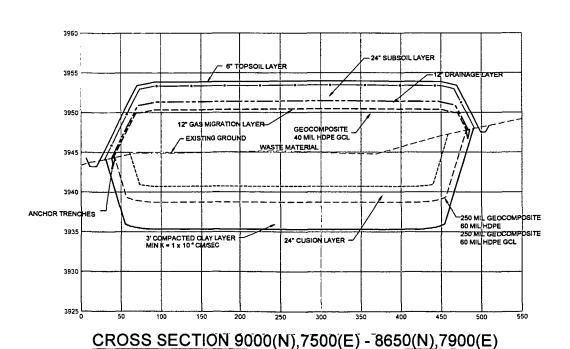
TABLE 3-4. CAMU PHYSICAL CONFIGURATION PARAMETERS

COMPONENT	QUANTITY
Landfill Footprint Width	455 Feet
Landfill Footprint Length	455 Feet
Area of Landfill Footprint	202,500 Square-Feet
Net Landfill Waste Capacity	70,000 Cubic-Yards
CELL COMPONE	NT
Depth of Landfill Excavation	8 Feet
Slope of Landfill Bottom Sides	3:1
Area of Landfill Excavation Bottom	160,801 Square-Feet
Area of Landfill Excavation Slopes	48,383 Square-Feet
Total Area of Landfill Excavated Surface	209,184 Square-Feet
Volume of Excavation	61,304 Cubic-Yards
Volume of 3' Clay Liner	23,243 Cubic-Yards
Volume of GCL	325 Cubic-Yards
Volume of Geogrids	325 Cubic-Yards
Volume of FML Liners	52 Cubic-Yards
Volume of Cushion Material	15,456 Cubic-Yards
Net Excavated Waste Capacity	16,066 Cubic-Yards
COVER COMPONE	NT
Slope of Landfill Cap Sides	5:1
Height of Landfill Fill	17 Feet
Area of Top of Landfill Cap	81,225 Square-Feet
Areas of Landfill Cap Sides	128,291 Square-Feet
Total Area of Landfill Cap	209,516 Square-Feet
Volume of Landfill Cap	90,745 Cubic-Yards
Volume of Gas Migration Material	7,760 Cubic-Yards
Volume of GCL Liner	129 Cubic-Yards
Volume of FML Liner	39 Cubic-Yards
Volume of Geogrid	163 Cubic-Yards
Volume of 1' Gravel Drain	7,760 Cubic-Yards
Volume of 2.5' Cover Soil	19,400 Cubic-Yards
Net Cap Waste Capacity	55,495 Cubic-Yards



# CROSS SECTION 8600(N),7300(E) - 9050(N),7750(E)

SCALE: (H) 1"=60' (V) 1"=6'



SCALE: 1"=60' SCALE: (H) 1"=60' (V) 1"=6'

DESIGN ANALYSIS REPORT
ASARCO EAST HELENA
CORRECTIVE ACTIONS MANAGEMENT
UNIT (CAMU)

TYPICAL CAMU PHASE 2 CELL CROSS-SECTIONS

**CAMU PLAN VIEW** 

SCALE: 1"=100'

FIGURE

a 1300 ( mass

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1 mm

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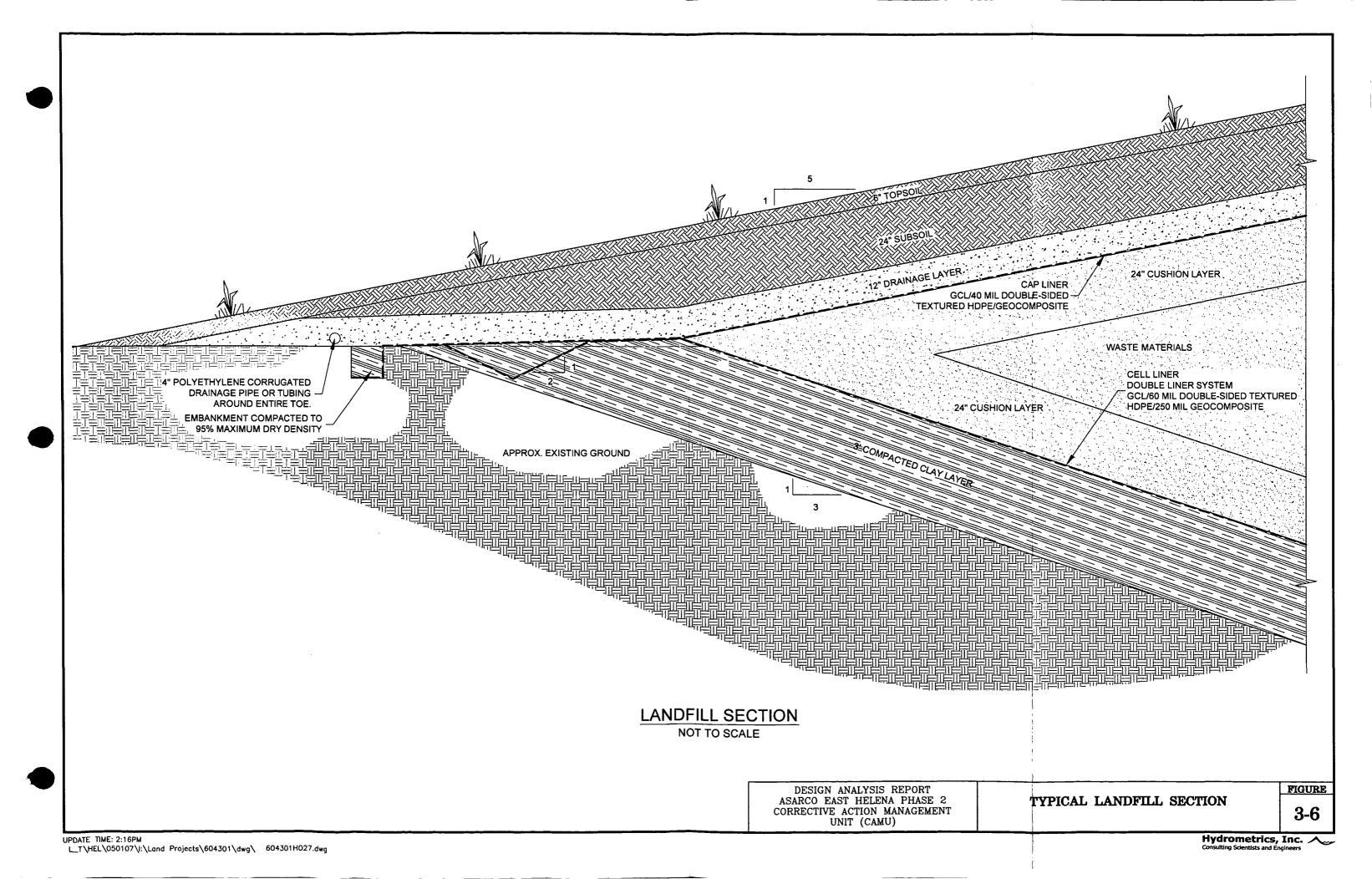
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3-5



The stress analysis completed for the design of this liner is included in Appendix C. This analysis includes determination of the stress placed on the membrane by its own weight prior to filling, during filling due to lifts of waste being placed against the cell side slopes, and following filling due to settlement of the cell foundation from the weight of the cell Other considerations in the design of the liner include the chemical overburden. compatibility of the liner and the waste material, the survivability required for the liner, and construction considerations.

As discussed in Section 3.4.2, wastes to be placed in the CAMU Phase 2 Cell are primarily demolition debris and waste soils containing elevated arsenic and metals concentrations. These wastes are compatible with the selected liner materials.

Landfill liners are required to have characteristics that help ensure a high degree of survivability for the liner. However, due to the nature of the construction debris being placed in the CAMU Phase 2 Cell the geomembranes were design to meet very high survivability The following minimum characteristics for very high survivability specifications. geomembranes (Koerner, 1998) were included in the material specifications for the geomembrane:

Thickness	<u>40 mils</u>
Tensile Strength (ASTM D882)	74 lb/in.
Tear Strength (ASTM D1004 Die C)	20 lb.
Puncture Strength (ASTM D4833)	45 lb.
Impact Strength (ASTM D3998 modified)	15 ft-lb.

Finally, construction considerations were taken into account in the liner design. Although a 40-mil HDPE will satisfy the strength and survivability requirements for design, the 60-mil HDPE double-sided textured geomembrane used in the cell design provides an additional factor of safety during the critical period of increased stress that may occur when the CAMU is being filled.

#### 3.7.1.2 Secondary Composite Liner

The secondary composite liner ensures that any leakage through the primary FML is collected by the leak detection, collection, and removal (LDCR) system and prevents migration of groundwater into the CAMU Phase 2 Cell. It consists of a 60-mil, double-sided textured HDPE FML, identical to the primary FML in design, underlain by a geosynthetic clay liner and 3 feet of compacted clay.

As discussed in Section 3.4.1, EPA has required that a GCL be included above the clay liner to ensure a permeability of 10<sup>-7</sup> centimeters-per-second as required by 40 CFR 264 subpart N.

#### 3.7.1.3 Cap Composite Liner

This component of the CAMU Phase 2 Cell cap closes the CAMU Phase 2 Cell and prevents infiltration of precipitation. It consists of a 40-mil double-sided textured HDPE FML, underlain by a geosynthetic clay liner (GCL). The geosynthetic clay liner will be needle punch reinforced GCL comprised of a uniform layer of granular sodium bentonite encapsulated between a scrim reinforced non-woven and a virgin staple fiber non-woven geotextile. The needle-punched fibers should be thermally fused to the scrim reinforced non-woven geotextile to enhance the reinforcing bond. All seams must be overlapped a minimum of 12 inches and sealed with powdered bentonite sealing compound. Seams must be oriented parallel to the line of maximum slope. No horizontal seams should be allowed on the slopes.

An HDPE geomembrane was chosen for this FML to ensure that the permeability of the cap liner is no less than the cell liner system, as required by 40 CFR 264 subpart N. In addition to acting as a component of the composite liner, the GCL covering the waste material provides a smooth surface for installation of the cap FML and provides an additional factor of safety in preventing percolation through the cap.

#### 3.7.2 Leachate Systems

The primary leachate collection and removal (PLCR) system and the leak detection, collection and removal (LDCR) system will be constructed of geocomposite materials with a minimum

transmissivity of 3 x 10<sup>-5</sup>m<sup>2</sup>/sec. The leachate collected in the leachate system will be removed through individual standpipes placed in each leachate system layer. Unlike in the CAMU Phase 1 Cell, these pipes will consist of individual vertical 24-inch HDPE access pipes, which allow collection, pumping, and withdrawal of leachate without penetrating the cell liners. This revised design should allow the two leachate systems to be emptied more easily.

In the design analysis of the CAMU Phase 2 Cell, Hydrologic Evaluation of Landfill Performance Modeling (HELP 3) was performed to evaluate the leachate generation potential of the CAMU Phase 2 Cell. Output from this model was used to check sizing of leachate system piping and flow capacities of drainage composite materials.

The HELP 3 model indicated that no leachate was expected to be generated following the filling of the cell. Tables 3-5 and 3-6 summarize the results of this modeling. However, if leachate is produced or if storm water enters the cell during construction, it will be collected and transported to the adjacent Asarco Lead Smelter for treatment in the existing High Density Sludge (HDS<sup>TM</sup>) water treatment system in accordance with the existing MPDES Permit or transported to a licensed Treatment, Storage, and Disposal Facility (TSDF) should the HDS<sup>TM</sup> water treatment system be removed.

HELP 3 was also performed to evaluate leachate generation and runoff during the filling of the cell. Output from this model indicates the designed leachate collection system capacity will be exceeded during a 25-year, 24-hour storm when the fill in the cell is less than 60 inches. Therefore, during construction, the construction contractor will be required to have pumps ready in case of a significant rainfall event.

# 3.7.2.1 Primary Leachate Collection and Removal (PLCR) System

This CAMU Phase 2 Cell component is designed to collect any leachate associated with the waste material. Waste material deposited in the CAMU cell will be underlain by a geocomposite which has two layers of 8 oz. non woven geotextile which will act as a filter barrier between the waste and the geonet drain layer. This geocomposite drain layer will have a minimum transmissivity of 0.145 gallons/ minute/foot (3x10<sup>-5</sup> m²/sec) at 4,000 pounds

TABLE 3-5. AVERAGE ANNUAL PRECIPITATION AND LEACHATE VOLUMES FOR 80 YEARS

	Inches	Cubic Feet	Percent
Precipitation	11.36	210226.7	100.00
Runoff	0.097	1,796	0.855
Evapotranspiration	11.237	208033	98.957
Lateral Drainage Collected From SWCR	0.00203	37.6	0.01790
Percolation/Leakage Through Cap Composite Liner	0.00000	0.00000	0.00000
Lateral Drainage Collected From PLCR	0.00000	0.00000	0.00000
Percolation/Leakage Through Primary FML	0.00000	0.00000	0.00000
Lateral Drainage Collected From LDCR	0.00000	0.00000	0.00000
Percolation/Leakage Through Secondary Composite Liner	0.00000	0.00000	0.00000

SWCR - Surface Water Collection and Removal

PLCR - Primary Leachate Collection and Removal

LDCR - Leak Detection Collection and Removal

TABLE 3-6. PEAK DAILY PRECIPITATION AND LEACHATE VOLUMES FOR 80 YEARS

	Inches	Cubic Feet
Precipitation	1.62	29991
Runoff	0.400	7399
Drainage Collected From Layer SWCR	0.013	246
Percolation/Leakage Through Cap Composite Liner	0.00000	0.00000
Drainage Collected From PLCR	0.00000	0.00000
Percolation/Leakage Through Primary FML	0.00000	0.00000
Drainage Collected From LDCR	0.00000	0.00000
Percolation/Leakage Through Secondary Composite Liner	0.000000	0.00000

per square foot of confining pressure, as required by the performance standards discussed in Section 2.3. The performance of the PLCR was checked using HELP 3 modeling, and found to prevent more than 12 inches of leachate from collecting above the primary liner, as shown in Table 3-6.

A geocomposite was selected as a drainage component primarily due to its economy when compared to a gravel layer. Perforated drainpipe embedded in a gravel drain layer has the advantage of common usage and design, but requires a minimum of 1 foot of cell depth. Geocomposites promote rapid transmission of liquids while requiring only 1/4 inch of cell depth. While the square-foot cost of geocomposite is comparable to drain gravel, the reduction in cell depth from use of the geocomposite in design resulted in major cost savings on the project.

The geocomposite drainage layer is laid on a 2 percent slope and drains to a collection trench along one edge of the CAMU Phase 2 Cell. The collection trench contains a perforated drain pipe enveloped in drain gravel, collects leachate from the geocomposite layer and directs it to the 24-inch diameter pipe sump for removal. Leachate removal is accomplished through the vertical standpipe that exits above the cell cap. The 24-inch standpipe is big enough to accommodate even a submersible pump, should one be needed, and provides a useful volume of pump storage capacity.

#### 3.7.2.2 Leak Detection, Collection, and Removal (LDCR) System

This system is designed to detect and collect any leakage through the Primary FML within 24 hours. Another geocomposite layer was used for the LDCR for the same reasons discussed for the PLCR. In fact, the system is identical to the PLCR in design with the geonet used as a composite between two 8 oz. non-woven geotextiles. As for the PLCR, the geocomposite layer is sloped approximately 2 percent to a collection trench where leachate is directed to a sump for removal. Maximum travel time to the sump for this design is approximately three hours, which is less than the 24 hours required by performance standards. Appendix C contains this analysis.

#### 3.7.3 Surface Water Collection and Removal (SWCR) System

This system allows surface precipitation to drain away from the surface of the Cap Composite Liner, and consists of a 1-foot thick layer of drain gravel on a 3 percent slope. This layer drains to a corrugated drain pipe embedded in a gravel-filled trench at the toe of the CAMU Phase 2 Cell cap slope. The drain pipe outlets to a shallow infiltration and evaporation pond adjacent to the CAMU Phase 2 Cell which prevents run-off from mixing with diverted run-on flows.

#### 3.7.4 Cover System

This component provides frost protection to the cap composite liner and, after seeding, protects the surface of the CAMU Phase 2 Cell from erosion. It consists of 6-inches of seeded topsoil overlying 24-inches of subsoil. The project specifications require the organic rich topsoil to be salvaged and stockpiled separate from the underlying subsoil to ensure a proper medium for seeding with grasses. The combination of cover system and SWCR provides a total of 3.5-feet of frost protection to the cap composite liner. The CAMU cover has been designed with a top slope of 3 percent and fairly flat side slopes of 5:1 to resist erosion and minimize maintenance.

#### 3.7.5 Groundwater Monitoring System

Finally, the CAMU Phase 2 Cell has been designed and will be constructed with monitoring systems that can detect a failure of the CAMU Phase 2 Cell. As described in section 3.5.2.2, the first line of detection takes place in the LDCR. A secondary line of monitoring, consisting of ten groundwater monitoring wells, has been constructed around the CAMU Phase 2 Cell site and will be monitored on a semi-annual basis. A statistical analysis of the data from this monitoring will detect any impacts to the groundwater quality associated with the CAMU Phase 2 Cell. The sampling and monitoring plan, contained in Appendix D of this report, establishes a detection monitoring program in compliance with 264 Subpart F requirements.

#### 3.8 SEISMIC DESIGN

40 CFR 264.18 requires that the CAMU Phase 2 Cell may not be located within 200 feet of a fault that has had displacement in Holocene time. As discussed in the 2000 CAMU application, the U.S. Geologic Survey lists no record of a fault within 200 feet of the site. However, the U.S. Geologic Survey's seismic deaggregation website suggests that a 2500-year seismic event at the site proposed for the CAMU Phase 2 Cell will result in bedrock acceleration greater than 0.1 g (ARM 17.50.505). Therefore, the proposed location is in a seismic impact zone, and the CAMU Phase 2 Cell cap, leachate removal pipe, and gas extraction system pipe have been designed to resist the maximum horizontal acceleration in lithified earth material for the site. The CAMU Phase 2 Cell is to be located in Lewis and Clark County, Montana, which is listed in Appendix VI of 40 CFR 264. As shown in Figure 3-7 and based on data from the U.S. Geologic Survey, there is no known fault within 3,000 feet of the facility that has had displacement in Holocene time.

#### 3.9 LINER COMPATABILITY

HDPE was the selected liner material for the CAMU because of its resistance to inorganic chemicals, including acids (e.g. hydrochloric acid, sulfuric acid), bases (e.g. sodium hydroxide), metals (e.g. arsenic, cadmium and lead), and salts (e.g. calcium chloride or sodium sulfate). It is also generally resistant organic based acids. Review of chemical information provided by the manufacture (see Appendix C, attachment 1) shows the liner is resistant to most of the type of chemicals that have a potential to occur in CAMU leachate (inorganic acids, bases, metals and salts). (However, as discussed above, pH extremes in CAMU leachate are not expected and any leachate generated is expected to have a relatively neutral pH). HDPE was the liner material used in the CAMU Phase 1 Cell and is the most typical material selected for landfill liners because of its resistance to most inorganic acid and other inorganic chemicals.

Table 3-3 presents a list of sources of demolition materials and estimated quantities that would be disposed in the CAMU. Most of the materials associated with these structures are inorganic in nature and include:

- Residual lead based dusts associated with the cleaning and demolition project
- Concrete and brick masonry associated with building materials

- Asbestos based building materials (transite etc).
- Wood, plastic, rubber, fiberglass and other miscellaneous building materials.
- Timbers associated with the highline trestle and removed railroad ties.

Most of these materials including residual lead based dusts, brick, concrete are inorganic in nature and corrosive leachate from the materials is not likely. Similarly, most of the organic based building materials (wood, plastic, rubber, etc.) are generally chemically stable and leachate from these materials is not likely. A potential exception is timbers associated with the highline trestle and railroad ties. Based on field observations, it is apparent these timbers were likely treated with creosote. However, the timbers are old and the constant exposure to over fifty years of weather has reduced any serious potential for leachate of creosote-based chemicals from these timbers.

As the chemical resistance information in Appendix C, Attachment 1 shows, HDPE is generally less resistant to strong oxidizing agents (e.g. nitric acid or hydrogen peroxide) and many organically based chemicals (hydrocarbon based chemicals, oils or fuels, see Attachment 1 and Attachment 2). However, since no free liquids are allowed in the CAMU these organic based materials are not part of the waste stream that will be stored in the CAMU Phase 2 cell.

As noted by the liner manufacture (see Appendix C, Attachment 1) the chemical compatibility of the liner for a given use is not only a function of the chemical type, but also the concentration. The chemical compatibility tables in Appendix C, Attachments 1 and 2, assume high concentration liquids in direct contact with HDPE materials. As discussed in Appendix C, while contact with 100% concentration of certain organic chemical may be unacceptable, concentrations at lower concentrations (0.1% is the example given) may be acceptable. Liner specific chemical compatibility testing was conducted by the Department of Energy (DOE) for a variety of organic chemicals, including creosote (see Appendix C, Attachment 3, Table B-1). The DOE's determination was that HDPE liner was acceptable for creosote concentrations in soils of 31,587 mg/kg or less, or for creosote leachate from the soils of 158,295 mg/l or less. It is unlikely the weathered timbers could generate creosote

leachate that would exceed 15.8%. However, prior to deposition of the timbers, representative samples will be collected, tested for leachate using the TCLP Method 1312.

## 4.0 PLACEMENT OF WASTE SOILS, SEDIMENTS AND DEMOLITION DEBRIS IN CELL

Materials will be placed and compacted in the cell to minimize voids, settlement, and damage to the liners. Smelter demolition debris and waste soils will be placed and compacted in the cell in lifts not to exceed 2 feet thick across the bottom of the cell. A detailed Waste Hauling Plan can be found in Appendix H.

All materials delivered to the cell for placement will require some segregation. This will allow consolidation of the materials during compaction and will result in a homogeneous mass with a minimal amount of voids. Specifically, bulk concrete and metal debris will be broken or otherwise reduced in size not to exceed 2 feet in diameter. Large organic material (e.g. timbers) and manufactured metal will be placed horizontally in the cell as flat as possible to minimize voids. Special care will be taken near the sides and bottom of the cell to place crushed slag or a minus 1/2" gravel as a cushion layer to protect the liner systems against puncture. The project specifications require the contractor to use a 1/2" to 1/4" graded material as a protective layer (12-inches thick) adjacent to the bottom and sides of the cell and an additional 12-inches of minus 1/2" material over that. This material shall be free of oversized material and sharp objects.

A dust control program will be required to minimize the creation and spread of dust during the excavation, loading, hauling, placement and compaction activities.

The contractor shall be required to have readily available pumps capable of pumping 400 gallons per minute in the event of a significant rainfall event and shall provide a temporary 20-mil RPE Liner for the waste material placed in the CAMU Phase 2 Cell. Special care must be taken to ensure that the waste is covered prior to significant occurrences of precipitation. In addition, the Contractor shall ensure that the waste is placed in a manner that will ensure that the water which falls on the temporary liner will drain to a sump without coming in contact with the waste material and without significant ponding of the water on the temporary liner. The water reaching the sump shall immediately be discharged to the storm

water retention pond shown on Sheets 26 and 27 of Appendix I. Therefore, the storm water retention pond shall be constructed prior to placing waste material into the CAMU Phase 2 Cell. Any storm water coming in contact with the waste material shall not discharged, but shall be removed to the Plant water treatment system, which has approximately one million gallons of excess storage capacity that will be reserved for this purpose.

#### 5.0 TEMPORARY CLOSURE AND MONITORING

The construction of the CAMU Phase 2 Cell will begin in 2007. Once the cell is excavated and the liner, leak detection, and leachate collection systems are constructed the cell will be filled with waste materials from both 2006 and 2007 demolition work. Placement of waste materials generated from 2006 demolition work will free up containment building storage space that may be used to store waste materials generated from demolition work after temporary closure of the CAMU cell before the end of the 2007 construction season. By the end of the 2007 construction season, a temporary cap constructed from 20 mil Reinforced Polyethylene (RPE 25) with stitched z-fold seams will be placed over the waste, using sandbags to hold it in place. Prior to placement of the liner, the surface of the waste will be graded to drain, rolled smooth, and covered with a 10-ounce cushion fabric. Sandbags placed in a 5-foot grid will be installed to anchor the middle portion of the cap and edges will be anchored in trenches. The cell has been designed to contain 40,000 cubic yards of material in the excavated portion of the cell. This will allow the contractor to grade the waste material level with the existing ground surrounding the CAMU Phase 2 Cell which will help to promote runoff from the temporary cover. The temporary RPE 25 cap may also be used at the conclusion of subsequent construction seasons if it is stored carefully in between uses. However, the cushion fabric will need to be replaced. Freezing and wind and other weather related damage may limit the useful life of the temporary cap.

This temporary component of the CAMU Phase 2 Cell cap will help to reduce infiltration of precipitation into the waste material until final capping of the CAMU Phase 2 Cell is completed. If it is to be reused, the liner may be divided into small enough panels to remove from the CAMU and then reanchored with sandbags on adjacent land that is out of the way of construction. The liner will need to be inspected prior to reuse in order to insure that it is still in adequate condition for use. If it is determined that it is not in a sufficient condition to be reused, it will need to be well perforated so that it will not hold water, prior to placing it in the CAMU cell, or placed over the top of the waste material prior to capping the cell. The Operation and Maintenance Plan (O&M Plan) addresses temporary closure activities of the CAMU and is located in Appendix E.

#### 6.0 FINAL CLOSURE AND MONITORING

Upon completion of placement of demolition debris and waste soils in the CAMU Phase 2 Cell, the CAMU cap will be constructed. This component of the CAMU Phase 2 Cell cap closes the CAMU Phase 2 Cell and prevents infiltration of precipitation. A Post Closure Plan will be prepared to address post closure activities of the CAMU. A copy of the Post Closure Plan is included in the Operation and Maintenance Plan and is located in Appendix E.

#### 7.0 STANDARD PLANS AND SPECIFICATIONS

Final design drawings for CAMU construction will be submitted pending EPA review of this Design Analysis Report. Designated Divisions and Sections of the 1996 Standard Specifications for Road, Bridge, and Municipal Construction as adopted by the Montana State Department of Transportation (MDOT, 1996) will be utilized for the construction specifications. Construction specifications and design drawings can be found in Appendix I and J, and a preliminary construction schedule is found in Appendix F.

#### 8.0 REFERENCES

- ASARCO Consulting, Inc., 2003. RCRA Facility Investigation. Asarco East Helena Plant.
- Hydrometrics, 1990. Comprehensive Remedial Investigation/Feasibility Study, Asarco Inc., East Helena, Montana. January, 1990.
- Hydrometrics, 2000. Design Analysis Report Asarco East Helena Corrective Action Management Unit (CAMU), July 2000.
- Hydrometrics, 2006. Asarco East Helena CAMU (RCRA Landfill) Phase 2 Cell Geotechnical Investigation, October 2006.
- Koerner, 1998. Designing With Geosynthetics, Fourth Edition. Prentice-Hall, Inc.
- Montana State Department of Transportation (MDOT), 1996. Standard Specifications for Road, Bridge, and Municipal Construction, revised 1996.
- U.S. EPA, 1979. Processing and Utilization of Gas from Sanitary Landfills. By Lockman Associates and R.K. Han. EPA-600/2-79-001. U.S. EPA, Cincinnati, Ohio.
- U.S. EPA, 1989. "Requirements for Hazardous Waste Landfill Design, Construction, and Closure." Seminar Publication EPA/625/4-89/022.
- U.S. EPA, 1993. "Quality Assurance and Quality Control for Waste Containment Facilities." Technical Guidance Document EPA/600/R-93/182.
- U. S. Geological Survey (USGS), 1992. Hydrogeology of the Helena Valley-Fill Aquifer System, West-Central Montana. Water Resources Investigation Report 92-4023, April 1992.

#### **Code of Federal Regulations**

- 40 CFR 258 Subpart B, Criteria for Municipal Solid Waste Landfills Location Restrictions.
- 40 CFR 264, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.
- 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.
- 40 CFR 270, EPA Administered Permit Programs: The Hazardous Waste Permit Program.

#### **Administrative Rules of Montana**

- 17.50.505, Standards for Solid Waste Management Facilities.
- 17.50.506, Design Criteria for Landfills.

#### APPENDIX A

SURFACE WATER HYDROLOGY

#### SOIL SURVEY OF LEWIS AND CLARK COUNTY AREA, MONTANA



USDA Natural Resources
Conservation Service

Web Soil Survey 1.1 National Cooperative Soil Survey 1/9/2007 Page I of 3

#### Map Unit Legend Summary

#### Lewis and Clark County Area, Montana

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
33B	Sappington-Amesha loams, 1 to 4 percent slopes	71.8	49.2
33C	Sappington-Amesha loams, 4 to 8 percent slopes	16.8	11.5
137B	Musselshell-Crago complex, 2 to 8 percent slopes	40.4	27.7
433E	Crago-Musselshell gravelly loams, 4 to 35 percent slopes	17.0	11.7

#### **RUSLE2 Related Attributes**

#### Lewis and Clark County Area, Montana

The court of the c	Pct of		<b>1/2</b> .		Representative value			
Map symbol and soil name	map unit	Hydrologic group	Kf.	T factor	% Sand	% Sin	% Clay	
338:							•	
Sappington	60	8	.37	2	41.6	37.4	21.0	
Amesha	35	B	.37	6	42.1	37.9	20.0	
33C:								
Sappington	50	В	.37	2	41.8	37.4	21.0	
Amesha	40	8	.37	5	42.1	37.9	20.0	
137B:								
Musselsheil	70	₽	.37	2	39.2	37.3	23.5	
Crago	25	8	.37	2	41.6	37.4	21.0	
433E:								
Crago	50	8	,37	2	41.8	37.4	21.0	
Musselshell	40	В	.37	2	39.2	37,3	23.5	

### Input Parameters for EFH 2 Software 1

#### Upgradient Drainage Area

Drainage Area

23.7 acres

Curve Number

75 Small Grain Straight Row + Crop Residue Cover-Poor Condition, Soil Type B

Slope

0.039 ft/ft

Longest Flow Path

1437 ft

25 yr, 24 hr Precip

2.3 in 1.4 in

25 yr, 6 hr Precip P<sub>2</sub>/P<sub>24</sub>

0.6087 since 0.518 < 0.6087 < 0.639 use Type I Distribution

#### CAMU Phase 2 Drainage Area - No Vegetation

Drainage Area

5.15 acres

Curve Number

86 Fallow - Bare, Soil Type B

Slope

0.04 ft/ft

Longest Flow Path

425 ft

25 yr, 24 hr Precip

2.3 in

25 yr, 6 hr Precip

1.4 in

P<sub>6</sub>/P<sub>24</sub>

0.6087 since 0.518 < 0.6087 < 0.639 use Type I Distribution

#### CAMU Phase 2 Drainage Area - with Vegetation

Drainage Area

5.15 acres

Curve Number

69 Pasture, Grassland-Fair Condtion, Soil Type B

Slope

0.04 ft/ft 425 ft

Longest Flow Path 25 yr, 24 hr Precip

2.3 in 1.4 in

25 yr, 6 hr Precip P<sub>6</sub>/P<sub>24</sub>

0.6087 since 0.518 < 0.6087 < 0.639 use Type I Distribution

<sup>&</sup>lt;sup>1</sup>Natural Resource and Conservation Services (NRCS), March 2003 Version 1.1.0

Client: Asarco, LLC

County: Lewis and Clark

State: MT

Practice: CAMU Phase 2 Cell 25-yr, 24-hr Storm Runoff-Upgradient of site

Calculated By: M. Rhodes

Date: 11/7/2006

Checked By:

Date:

Drainage Area:

23.7

Acres (user entered value)

Curve Number:

75

(user entered value)

Watershed Length:

1437 Feet

Watershed Slope:

3.9

Percent

Time of Concentration: Rainfall Type:

Peak Discharge (cfs)

0.42 1 Hours (calculated value)

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	25						
24-Hr rainfall (in)	2.3	•					
Ia/P Ratio	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Used	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Runoff (In)	0.54						
(ac-ff)	1.07	0.00	0.00	0.00	0.00	0.00	0.00
Unit Peak Discharge (cfs/acre/in)	0.307	0.000	0.000	0.000	0.000	0.000	0.000

Client: Asarco, LLC

County: Lewls and Clark State: MT

Practice: CAMU Phase 2 Cell 25-yr, 24-hr Storm Runoff-Cap no Vegetation

Calculated By: M. Rhodes Date: 11/7/2006

Checked By: \_\_\_\_\_ Date: \_\_\_\_

Drainage Area: 5.15 Acres (user entered value)
Curve Number: 86 (user entered value)

Watershed Length: 425 Feet
Watershed Slope: 4 Percent

Time of Concentration: 0.11 Hours (calculated value)

Rainfall Type: 1

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	25						
24-Hr rainfall (in)	2.3						
la/P Ratio	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Used	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Runoff (In)	1.08						
(ac-ft)	0.46	0.00	0.00	0.00	0.00	0.00	0.00
Unit Peak Discharge (cfs/acre/in)	0.730	0.000	0.000	0.000	0.000	0.000	0.000
Peak Discharge (cfs)	4						

Client: Asarco, LLC

County: Lewis and Clark

State: MT

Practice: CAMU Phase 2 Cell 25-yr, 24-hr Storm Runoff-Cap with Vegetation

Calculated By: M. Rhodes

Date: 11/7/2006

Checked By: \_\_\_\_\_

Date:

Drainage Area:

5.15

Acres (user entered value)

Curve Number:

69

(user entered value)

Watershed Length:

425 Feet

Watershed Slope:

4 Percent

Time of Concentration:

0.18

Hours (calculated value)

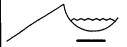
Rainfall Type:

1

Storm Number	1	2	3	4	5	6	7
Frequency (yrs)	25						
24-Hr rainfall (in)	2.3						
la/P Ratio	0.39	0.00	0.00	0.00	0.00	0.00	0.00
Used	0.39	0.00	0.00	0.00	0.00	0.00	0.00
Runoff (in)	0.33						
(ac-ft)	0.14	0.00	0.00	0,00	0.00	0.00	0.00
Unit Peak Discharge (cfs/acre/in)	0.238	0.000	0.000	0.000	0.000	0.000	0.000
Peak Discharge (cfs)							

#### APPENDIX B

MONITORING WELL LOGS AND GROUNDWATER DATA



HYDROMETRICS INC. Consulting Scientists and Engineers Helena, Montana

Monitoring well

Hole Name: MW-8

Date Hole Started: 9/25/06 Date Hole Finished: 9/26/08

INTERVAL

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana

Property Owner: Asarco Inc.

Legal Description: Sec 36 T10N, R3W Descriptive Location: South of CAMU; East of

CAMU Phase II

Recorded By: John Bergin Drilling Company: Boland Drilling

Driller: Rick & Chuck Drilling Method: Air Rotary Drilling Fluids Used: Air

Purpose of Hole: CAMU Monitoring Well

Target Aquifer:

Hole Diameter (in): 4.5\* Total Depth Drilled (ft): 70 WELL COMPLETION Y/N DESCRIPTION

Well installed? Υ 2-inch, flush threaded, Sch 40, PVC

4" Steel Surface Casing Used? Y

Screen/Perforations? 0.020-inch slot, Sch 40 PVC 45-65 Sand Pack? 1020 Silica Sand 43-70 0 - 43 Annular Seal? Bentonite Chips Surface Seal? Cement 0-0.5

DEVELOPMENT/SAMPLING

Well Developed? Y Bailer/pump

Water Samples Taken? N Boring Samples Taken? N

Static Water Level Below MP: 50.91

Date: 11/2/06

MP Description: Top of Casing

MP Height Above or Below Ground (ft):

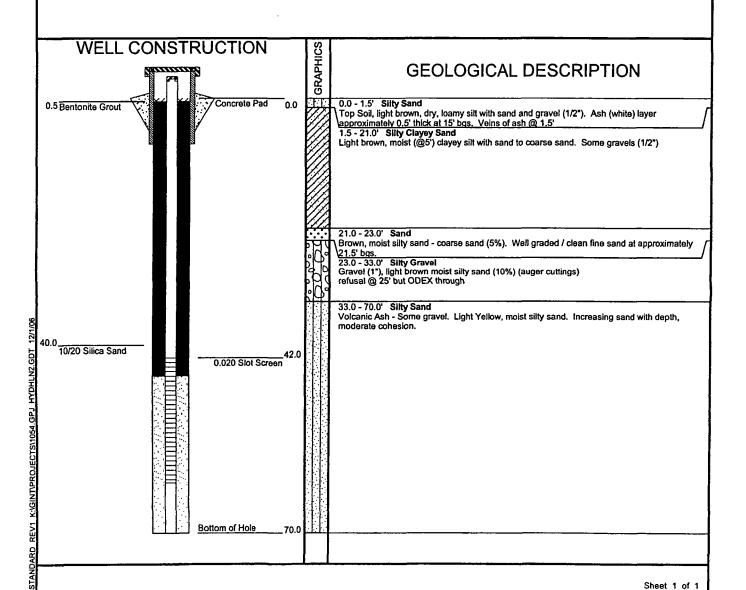
Surface Casing Height (ft):

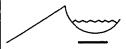
Riser Height (ft):

Ground Surface Elevation (ft):

MP Elevation (ft):

Remarks:





## HYDROMETRICS INC. Consulting Scientists and Engineers

Helena, Montana

Monitoring well

Hole Name: MW-9

INTERVAL

Date Hole Started: 9/26/08 Date Hole Finished:

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility State: Montana County: Lewis and Clark

Property Owner: Asarco Inc.

Legal Description: Sec 36 T10N, R3W Descriptive Location: Southwest of CAMU;

South end of CAMU Phase II

Recorded By: John Bergin Drilling Company: Boland Drilling

Driller: Rick & Chuck Drilling Method: Air Rotary Drilling Fluids Used: Air

Purpose of Hole: CAMU Monitoring Well

Target Aquifer:

Hole Diameter (in): 4.5" Total Depth Drilled (ft): 70 WELL COMPLETION Y/N DESCRIPTION

Well Installed? 2-inch, flush threaded, Sch 40, PVC

4" Steel Surface Casing Used? Υ

Screen/Perforations? Υ 0.020-inch slot, Sch 40 PVC 50-70 48-70 Sand Pack? 1020 Silica Sand Annular Seal? Bentonite Chips 0.5-48 Y 0-0.5 Surface Seal? Cement

**DEVELOPMENT/SAMPLING** 

Well Developed? Υ Bailer/pump

Water Samples Taken? N Boring Samples Taken? N

Static Water Level Below MP: 56.90

Date: 11/2/06

MP Description: Top of Casing

MP Height Above or Below Ground (ft):

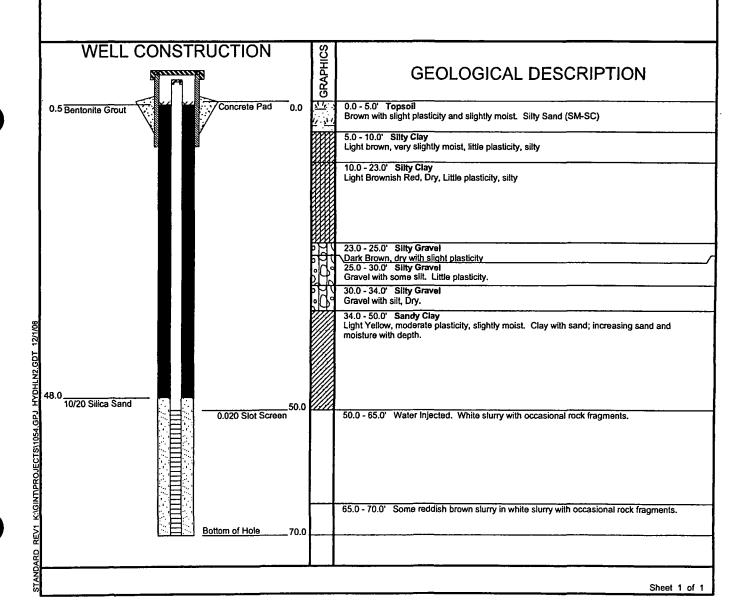
Surface Casing Height (ft):

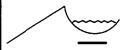
Riser Height (ft):

Ground Surface Elevation (ft):

MP Elevation (ft):

Remarks:





## HYDROMETRICS INC. Consulting Scientists and Engineers

Helena, Montana

Monitoring well

Hole Name: MW-10

Date Hole Started: 9/27/06 Date Hole Finished:

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana

Property Owner: Asarco Inc.

Legal Description: Sec 36 T10N, R3W Descriptive Location: Southwest of CAMU; Northeast edge of CAMU Phase II

Recorded By: John Bergin Drilling Company: Boland Drilling

Driller: Rick & Chuck Drilling Method: Air Rotary Drilling Fluids Used: Air

Purpose of Hole: CAMU Monitoring Well

Target Aquifer:

Hole Diameter (in): 4.5" Total Depth Drilled (ft): 70

WELL	COMPLETION	Y/N	DESCRIPTION

INTERVAL

Well Installed? 2-inch, flush threaded, Sch 40, PVC

Surface Casing Used? 4" Steel

Screen/Perforations? 0.020-inch slot, Sch 40 PVC 42-62 Sand Pack? 1020 Silica Sand 40-62 Annular Seal? **Bentonite Chips** 0.5 - 40Surface Seal? Cement 0-0.5

DEVELOPMENT/SAMPLING

Well Developed? Υ Bailer/pump

Water Samples Taken? N Boring Samples Taken? N

Date: 11/3/06

Static Water Level Below MP: 38.24

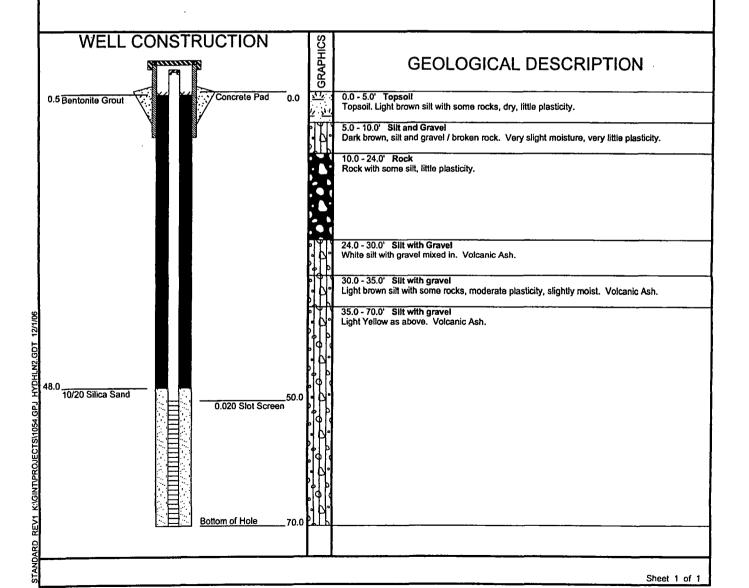
Surface Casing Height (ft):

Riser Height (ft):

MP Description: Top of Casing MP Height Above or Below Ground (ft): Ground Surface Elevation (ft):

MP Elevation (ft):

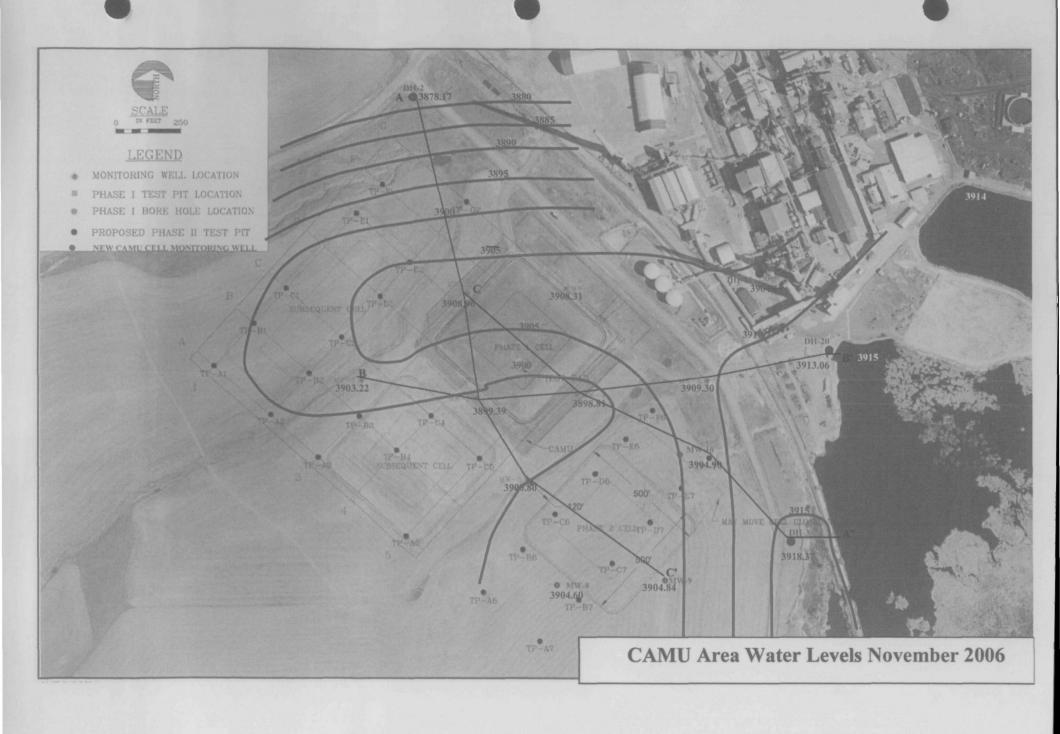
Remarks:

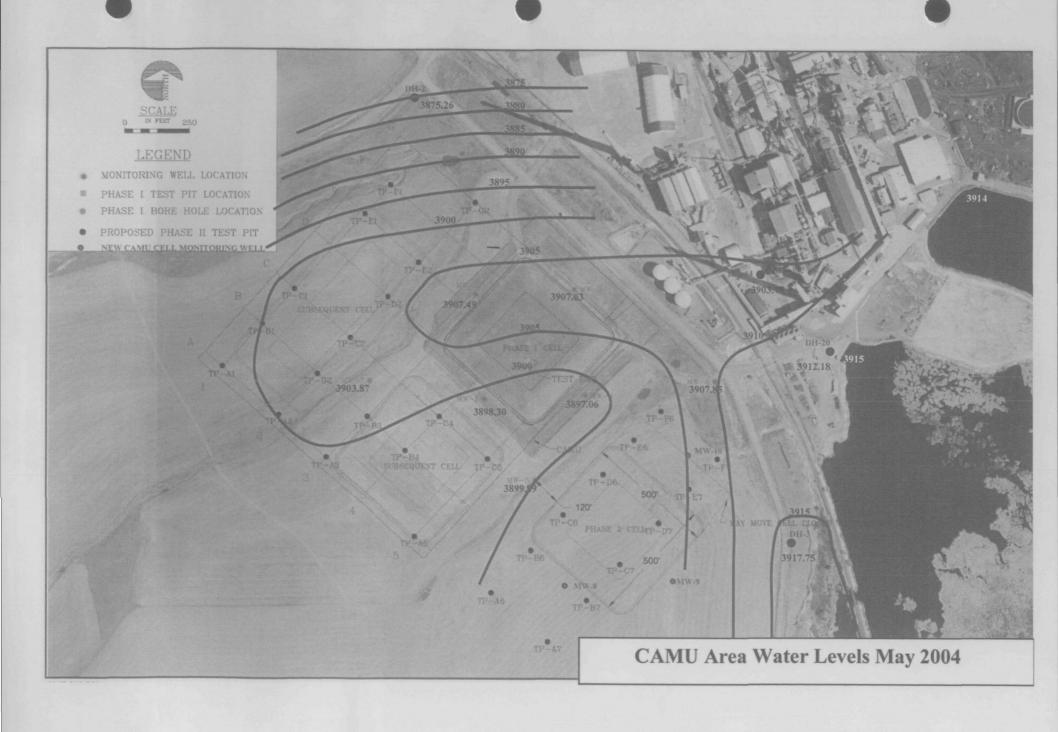


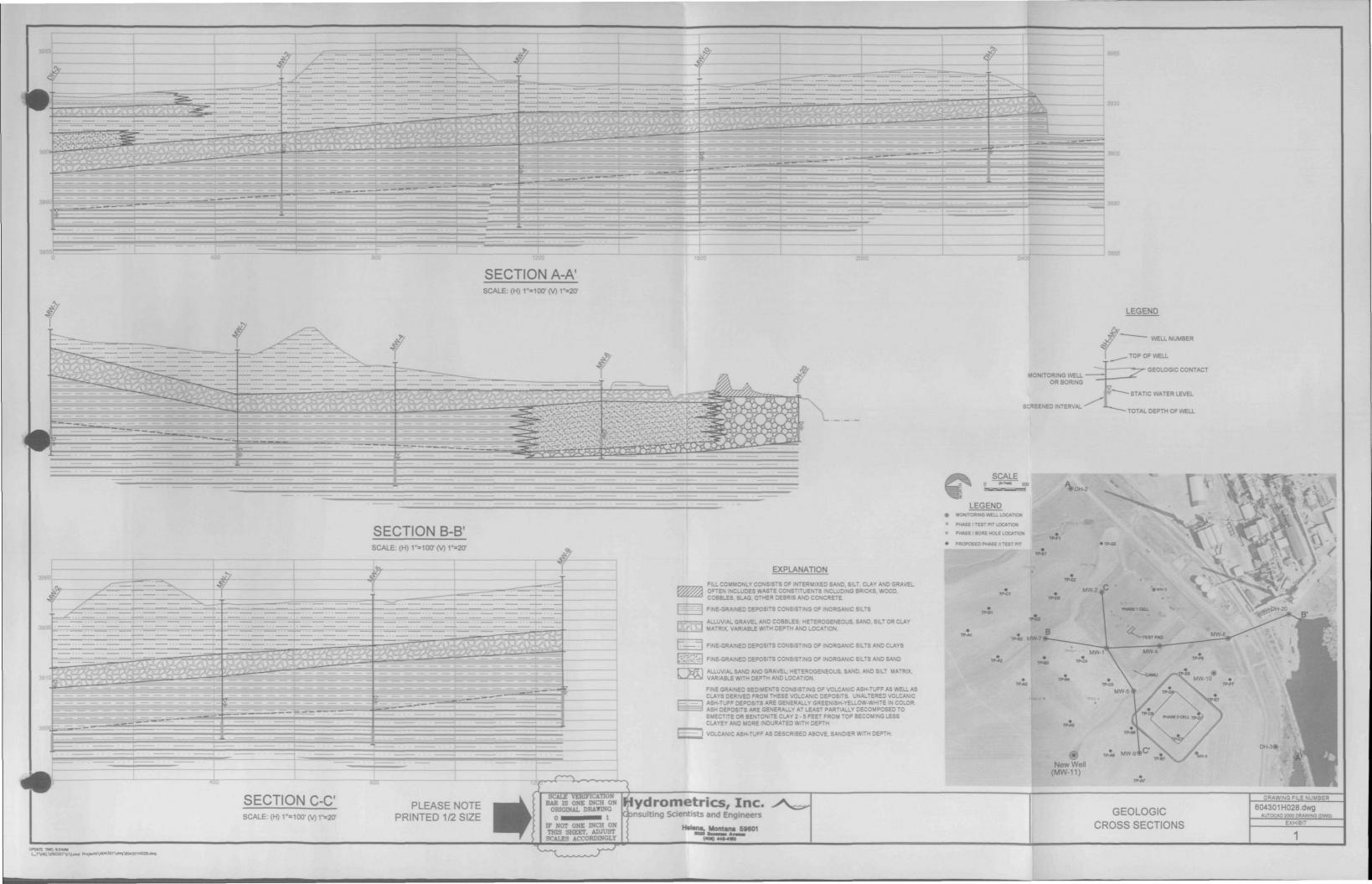
# Color Map(s)

The following pages contain color that does not appear in the scanned images.

To view the actual images, contact the Region VIII Records Center at (303) 312-6473.







APPENDIX C

**DESIGN ANALYSIS** 

#### Liner Design

Calculations for the flexible membrane liner (FML) include:

- Thickness Considerations
- Stress on FML from FML weight on side slopes
- Stress carried by FML during placement of waste
- Stress carried by FML from subsidence
- Liner Survivability

#### Assumptions used in the calculations:

- Assumed FML specific gravity = 0.94
- Assumed friction angle between FML and Soil = 25°
- Assumed friction angle between FML and GCL or Geotextile = 6°
- Assumed FML thickness = 60 mil
- Assumed average density of waste = 130 pcf
- Assumed internal friction angle of waste = 30°

The calculations were performed using guidance found in Koerner, R.M., Designing with Geosynthetics, Second Edition, 1990., and Koerner, R.M., Designing with Geosynthetics, Fourth Edition, 1998.

The following calculations show the selected 60 mil HDPE liner has sufficient thickness, strength, and survivability characteristics for application in the Phase 2 cell.

#### LINER-DESIGN

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2. Che	ck FML S	Stress, o, Before	Waste Pla	cement F	rom FML	Weight (	On Slope	es.		Figure 3	3-6 <sup>2</sup>		
		Steepest side slo											
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		=	$[G_s \times \delta_w]$										
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			Least am	0.02									
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#### LINER-DESIGN

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ļ ——	FS =	287280	psf /	321.25	nsf	<del> </del>	<del> </del>	<del> </del>	<del> </del>	<del>                                     </del>	<del> </del>	<del> </del>	<del> </del>
<del>                                     </del>	=	894.2692438			OK	Table 5.	171	<del> </del>	<del>                                     </del>	<del> </del>	<del> </del>	<del>                                     </del>	<del> </del>
-		034.2032430	<del>-</del> -	- 10	<u> </u>	rable J.	<del>''</del>	<del> </del>	<del>                                     </del>	<del>                                     </del>	<del>                                     </del>	<del> </del>	<del> </del>
3 Chec	k Tensio	n Stress, σ, Carr	ed By Pri	mary Ger	membra	ne During	Filling	1		Section	5.6.8 <sup>1</sup>	<del>                                     </del>	<del>                                     </del>
		- F <sub>Below</sub> ) / t			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		, <u>.</u>	<del>                                     </del>	<del>                                     </del>	230001	1		<del> </del>
			/s \				<del></del>	<del> </del> -		<del> </del> -	ļ	<del> </del>	<del> </del> -
<b></b> _	Above =	W x cos(β) x tan			<u> </u>	<u> </u>	<u> </u>	<u></u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<b> </b>
		W=	W <sub>W</sub> - T <sub>W</sub>			f waste -	Internal	Friction I	Force or	Edge of	Waste		L
		_		$0.5 \times D_L^2$						<u></u>	L		l
			=	0.5 x (	2.5	ft) <sup>2</sup> x	3	x	130	pcf		1	l
			=	1218.8	lb/ft								<u> </u>
				σ <sub>H</sub> x tan(			1		· · · · ·	<u> </u>			
1			<del>''</del>		K <sub>O</sub> x σ <sub>V</sub>								<del></del>
$\vdash$		<del> </del>	ļ	УН **		1 - sin ¢	ļ	<del> </del>	<b> </b>				
<b></b>		ļ <u> </u>	ļ				ļ <u>.</u>		<b> </b>	ļ		<del> </del>	
			ļ		=	1 - sin(	30	ال	ļ		L	ļ	<u> </u>
<u> </u>					=	0.5					L		
					σ <sub>V</sub> =	γ xD <sub>L</sub> / 2	1						
					=	130	pcf x	2.5	ft/2_				
	-				=								
				σ <sub>H</sub> =	0.5		162.5	psf					
				=	81.25		ļ						
			T <sub>W</sub> =	81.25		tan(	30	°) x	2.5	ft			
			- **	469.1			"	<del>-</del>	<del></del>				
<del>  </del>		184-	4240.0			1b/6		<del></del>	<del> </del>			<u> </u>	<u> </u>
<del></del>		VV=	1218.8		469.1	lb/ft							
<b></b>		<u> </u>	749.65		<u></u>	45.1-	0	<u> </u>					
		W x cos(β) =		749.65		18.43	)			L		L	
<b></b>			=	7,1.2			L		ļ				
	=	711.2036646		tan(	25	უ							
	=	331.6397153								ļļ			
	F <sub>Below</sub> =	W x cos(β) x tan											
1	=	711.2036646	ibxtan(	6	°)								
	=	74.75051729											
	331.64		74.751		60	/1000"	/12"/')						
	256.89	lb/ft_/	0.005	ft									
=	51378	psf											
	FS=	σ / σ <sub>actual</sub>											
	=	287280	psf/	51378	psf		-						
	=	5.591515763			<u>OK</u>	Table 5.1	7 <sup>1</sup>						
		0.00 10 107 00					-						
4 Chec	k Minim	um Thickness for	General	Membran	e Installa	tion Survi	vability			Table 5.	113		
	100 M	mil for High Surv	ivability t	inical of l	andfill line	ers and co	vers			. 45/6 0.			
t <sub>MIN</sub> =			>=				,,,,,,						
<del></del>	60	mil		40	11111	OK		<del></del>				<del></del>	
5 Ob ==	. To = -!-	n Ctroco - Ag	Cilling D	o to Cub	idoses								
jo. Unech	<u>ciensio</u>	n Stress, σ, After	rising DU	e to Subs	sidelice (					}			
0.41		ttom of Landfill D	10 to 40 f	oot Ligish	4 of Eil =								
Settleme	ent of bo	uom of Landfill D	ue (0 191	oot neigh	LUI FIII =		ρ						

#### LINER-DESIGN

	ρ:	2	inches (s	ee settler	nent calc	ulation)							
Installed	Area of	Liner =	208,656	sf				<del> </del>	<del> </del> -	<del> </del>	<del> </del>	<del> </del> -	<del> </del>
						<del>                                     </del>			i	1	<u> </u>	<del> </del>	
Installed	Area of	Liner After Settle	ement =		208,731	sf							
Stra	ain, ε = (	208,731	-	208,656	) sf /	208,656	sf	<del> </del>	<del> </del>	├	<del> </del>	<del> </del>	<del> </del>
	ε=		sf /	208,656			i	<u> </u>					
	= 3	0.000359558	in/in										
σ=	εχΕ							-				<del> </del> -	
	0.0004	х	25000	psi									
σ=	8.9889	psi <	126	psi								ļ <u> </u>	
FS=	σ/σ <sub>actus</sub>	 										<u> </u>	
=		psf/	8.9889	psf						1	1		
=	14.017		10	<u>ok</u>		Table 5.	7 <sup>1</sup>						
*Friction	angle o	f 6° assumed for	FML inter	face with	either ge	ocomposi	te or GC	  L					
1,4		IM Designates	154. 0	45 . 47	0	Calai-		11-11 40					
Koerne	er, Robe	rt M., <i>Designing</i> I	vitn Geos	syntnetics	, Secona	Edition , 1	rentice	Hall, 19	90.		-	<del> </del> -	
<sup>2</sup> U.S. E		ental Protection A					Waste	Landfill [	Design,				
		ction, and Closur											
3 Koerne	er, Robe	rt M., Designing V	Vith Geos	ynthetics	, Fourth L	Edition , P	rentice F	Iall, 199	8	<u> </u>	<u> </u>		

### Geonet Design

Calculations for the geonet include:

- Stresses on the geonet during placement of waste
- Maximum fluid travel time through geonet to collection sump

### Assumptions used in the calculations:

- Geonet thickness of 250 mil
- Geonet has 8 oz. heat bonded non-woven geotextile on both sides
- Transmissivity of the geonet = 0.2 gal/min/ft

The calculations were performed using guidance found in Koerner, R.M., Designing with Geosynthetics, Second Edition, 1990., and U.S. Environmental Protection Agency, "Requirements for Hazardous Waste Landfill Design, Construction, and Closure" 1989.

The following calculations show the selected geonet has sufficient strength, and flow capacity for application in the Phase 2 cell.

### **GEONET-DESIGN**

GEONET	DESIGN		<del> </del>	1	<del>                                     </del>	T	<del></del>	T	T	Τ
OLUME!	DEGIOIN .		<del>                                     </del>			<del> </del>	<del> </del>		<del>                                     </del>	<del> </del>
Normal St	ess	σ <sub>N-ALLOWA</sub>	B1 E =	118	psi to	250	psi	use:	134	psi
	ckness, t =	- IN-ALLUVVA		mils to	910 mil		100.	use:		mils
2001101 1111		t =	<del></del>			<u> </u>	<del>                                     </del>	130.		inches
TALLOWABLE	=	1500	<del></del>			<u> </u>	<u> </u>		1	
Cell Side S			= S =	3	: 1	<del> </del>	<del>                                     </del>		<del> </del>	<del>                                     </del>
Cell Slope			= β =	18.43		<del> </del>	<b>†</b>	<u> </u>	1	<del>                                     </del>
Transmisi		T <sub>@3900PSF</sub>	<del></del>		gal/min/	/ft	<del> </del>	<del>                                     </del>	<del>                                     </del>	†
	,	W3300FSF	1		3-2	<del></del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>
1 Calcula	te the norma	al stress o	n the ge	onet		<del>                                     </del>	Section	5.6.8 <sup>1</sup>	1	<u> </u>
	γ x (H + D)	0.1033 0	ale ge		<del> </del>	<del>                                     </del>	2000011	7.5.5		
-N-ACTUAL	γ =	130	pcf		1	<del>                                     </del>	<del> </del>	<del> </del>	+	<del> </del>
<u> </u>	H =	10			<del>                                     </del>	-	<del> </del>	<del>                                     </del>	<del> </del>	<del>                                     </del>
<del></del>	D =		ft	<del></del>	<del>                                     </del>	<u> </u>		<del>                                     </del>	1	<b></b>
σ <sub>N-ACTUAL</sub> =		pcf x (	10	ft +	8	ft)				
= 14-40104E	2340		<del> </del>		<del>                                     </del>	<del>                                     </del>		<del> </del>	<del>                                     </del>	<del>                                     </del>
=	16.25								<u> </u>	
	FS=		psf /	16.25						
	=	8.24615	>=	1	<u>OK</u>		ļ		ļ	
		<u> </u>	L	<u> </u>		<u> </u>				
	te the shear	stress on	the geo	net		<u> </u>	Section	5.6.8	1	
τ=	F <sub>BELOW</sub> / t								<u> </u>	
 	F <sub>BELOW</sub> =									
	74.75052		0.25	in						
=	24.91684	psi						<u></u>	ļ	
		4500	noi 1	24.046020		<u> </u>			<del> </del>	
	FS =	1500	psi /	24.916839	psi OK					
		00.2003			<u>UN</u>			<b></b>	-	
3 Calcula	te required	slone		try:	2%		Figure 4	-15 <sup>2</sup>		<u> </u>
	maximum tr		to sumn		2.70		, iguie 4	,,,	<del> </del>	
=	Distance to	sump / S	eepage \	Velocity	·	<b>-</b>		-		
	D <sub>slope</sub> / V <sub>slope</sub>									
<u> </u>		25.2982								
<del>                                     </del>		sqrt(2) x (		m length		-	ļ		<del> </del>	<del></del>
		sqrt(2)x	407						-	
<b></b> -		575.585		1001					-	
	V <sub>slope</sub> =									
	▼ siope		f(i, σ)		-				<del> </del>	
<del> </del>		· -		1 / sqrt( 1 +	S <sup>2</sup> )		<u> </u>	· · · · · ·		<del></del>
-		}		1 / sqrt(1+		2)				
	·			0.3162278		/			<del> </del>	
				U.3162276 H / 2 * γ * ac					<del> </del>	
						420	nof ::	000/	10.40	01
			=		ft/2x	130	pcf x	cos(	18.43	
			=	616.6619		0.00=	<del></del>		<del>                                     </del>	
		T =	0.2	gal/min/ft =		0.0267	st/min		L	

### **GEONET-DESIGN**

### Liner Anchor Trench Design

### Calculations for the Anchor Trench Design include:

Anchor trench anchorage capacity for various anchor trench configurations

### Assumptions used in the calculations:

- Assumed friction angle between FML and Soil = 25°
- Assumed soil internal friction angle = 30°
- Unit weight of the soil = 130 pcf

The calculations were performed using guidance found in U.S. Environmental Protection Agency, "Requirements for Hazardous Waste Landfill Design, Construction, and Closure" 1989.

The following calculations show a "V" trench 1-foot deep with and embedment of 2-feet is adequate for application in the Phase 2 cell.

ANCHORAC	<u> </u>					T																	1
Calculate an	ochor con	neity for EM	nleced in	verious an	chorage co	Onfiguration	4		<del> </del>														·
Calculate an	na lor cap	actly for the	C piacou iii	VOITOUS UIT	GIO. DIGO S	ingo.uao	ř																
Friction Angl	nle.	= δ <sub>L</sub> =	25	° to	30	•	use:	25	•	<del> </del>													
Soil & Angle		= 4 =		° to	38		use:	30															
Slope Angle		=β=	18.43		<del></del>				<del> </del>														i — —
Soil Unit Wt	<u> </u>	= y =		pcf to	130	pcf	use:	130	pcf										$\vdash$				
Embedment		= 4 =	3			1			<u> </u>														
"V"Embedm		= Lv =	2			<del>                                     </del>	<b></b>		<u> </u>													-	
"V"Depth		= dv =	1			+			<del> </del>	<del> </del>									<del> </del>		·		
Cover Depth		= d. =				<del> </del>			├──	├								<b></b>					<del></del>
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1. Horizonta	al Embedo	nent Ancho		Figure 3-8	ļ	<del> </del> -	<del> </del>				<b></b>							<del></del>			<del> </del>		<del>                                     </del>
1.11011201114		Anchor Ca		i igaio o-o		<del> </del>			<del> </del>		<b> </b>							<del> </del>					
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<b>├</b> ──	<i></i>		γ x d <sub>e</sub>	-20	<u> </u>	<u> </u>	<del> </del>	<del>                                     </del>	<b> </b>	<b>↓</b>	<u> </u>		<b> </b>				ļ		<u> </u>	<del> </del>	<del></del>	<del> </del>	<del> </del>
┝──┼			130 260	pcf x	2	ft			<del> </del>	<del> </del>	<b></b>	<del></del>			<del> </del>		<del></del>	├	<del></del> -	<del> </del>	<del> </del>	<del> </del> -	<del></del>
<del>                                     </del>	= {		psf x		ft x tan(	75	ື)) / (1.5x		19.42	°) - sin(	19.43	*)x tan(	25	***	<del></del>		ļ		<del> </del>		<del></del>	<del> </del>	<del> </del>
<del>                                     </del>		285.1264		>=	256.8892	215/6	OK	1 -	10.43	7-3111	10.43	) V rain		11	<del></del>							<del></del>	<del> </del>
<del> +</del>	<del></del>	200.1204			100.0002	<del> </del>		<del>                                     </del>	<del> </del>	<del> </del>			<del> </del>					<del></del> -	<del> </del>				<del> </del> -
2. "V" Trenc	ch	t		Figure 3-8	-	$\vdash$		<del>                                     </del>	<del>                                     </del>	<del>                                     </del>								1	<del>                                     </del>				†
		Anchor Ca						<del>                                     </del>	<u> </u>	<del>                                     </del>							l						t
	T <sub>v</sub> =	tan(δ <sub>L</sub> ) [ q (	سا+سا-سا	/ cos(i)) +	(du x Lu x y	c / (2 x cos(	i))]	r -	<del> </del>		·	<del></del>											
<del></del>	<u>`</u>	1.5 x cos(β			<del>```</del>	<del>, ``</del>	<del></del>		<del> </del>	<del>                                     </del>	<del></del>		<del> </del>						<del> </del>	<del> </del>			<del>                                     </del>
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<del> </del>	T., =	tan (	25		260	psf (		R -	<del>                                     </del>	R+	2	ft/ cos(	45	9) + (	<del></del>	Я×		ft ×	130	pcf / (2 x c	00/	45	7)]
<del> </del>	<u>'\V</u>	1.5cos(		*) - sin(		°x tan(		5	<del> </del>			10 005(		"-	<del></del>	, A		11.	<del> </del> '**	PUITER	N3 (	<del></del>	'1'''
<del> </del>		431.0668		>=	256.8892		OK 25	Ψ	<del> </del>	<del>                                      </del>		<del> </del>	<del> </del>	<del></del>					<del>├</del>	<del> </del>	<del> </del>		<del> </del>
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3. Anchor To	rench			Figure 3-8	2%	<del> </del>	†	<del>                                     </del>	<del> </del>	<del> </del>	<del> </del>	<del>                                     </del>			<del></del>				<del> </del>		<del>                                     </del>	<del>                                     </del>	<del>                                     </del>
1		q x L <sub>H</sub> x tai	1(5 <sub>1</sub> ) + (K' +	K <sub>s</sub> ) tan(δ <sub>t</sub> )	(0.5 x y x d	4+ q x d	-)		1	<del> </del>	† <del></del>		· · · · · ·						<del>                                     </del>				· · · ·
		1.5 x cos(p	) - sin(β) x	tan(δ)		T		<del>                                     </del>	+	<del>                                     </del>	<del>                                     </del>				<del>                                     </del>			<del> </del>	<del> </del>	<del></del>	<del> </del>	<del></del> -	<del>                                     </del>
	T <sub>An</sub> =		psf x		ft x tan(	25	°) + 3.33x	tan(	25	°)(0.5 x	130	pcf x	1	ft' +	260	psf x	1	ft)					<b>—</b>
		1.5cos(	18.43	") - sin(	18.43	x ten(	25		<del> </del>		<del>                                     </del>		†			<del></del>					<b></b>		
	TA. =	680.7393		>=	256.8892		ОК	1		1	<b></b> -								$\vdash$	<del>                                     </del>			
<del>                                     </del>	T <sub>A0</sub> =		psf x	3	ft x tan(	25	°) + 0.833	x tan(	25	°)(0.5 x	130	pcf x	1	ft' +	260	psf x	1	ft)	<del>                                     </del>		<del> </del>	<del></del> -	<del> </del>
l		1.5cos(	·	") - sin(		3 x tan(		<u>in</u>	<del>                                     </del>	<del>                                     </del>	100	- ·	<del> </del>			<del> </del>	<del> </del>	<del> '''</del>	+		<del> </del>	<del> </del>	<del> </del>
<del>                                     </del>	Tan =	384.089		>=	256.8892		OK -	1	<del> </del>	<del>                                     </del>	<del></del>	<del> </del>	<del> </del>	<del>                                     </del>	<del>                                     </del>		<del>                                     </del>		<del></del>		<del> </del>	<del></del>	<del>                                     </del>
<del> </del>				<del>                                     </del>		<del>                                      </del>	<del></del>	+	+	<del>                                     </del>		<del></del>	<del> </del>		<del> </del>			├~~	<del> </del>	<del></del>		<del></del>	†
<sup>2</sup> U.S. Envir	ronmental	Protection	Agency, "R	equiremen	ts for Haza	rdous Wast	e Landfill C	esian.	<del></del>	<del> </del>			<del> </del>		<del> </del>	<del> </del>	<del> </del>	<del></del>	<del> </del>	<del></del>	<del></del>	<del></del>	<del> </del>
10	Constructi	Protection a	sure" (EPA	J625/4-89/	022), Augu	st 1989	1	1	<del> </del>	1	<del> </del>	<del> </del>	<del>                                     </del>	<del>                                     </del>						-	-		<del> </del>
					$\Box$																		
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### Coversoil Design

### Calculations for the Coversoil Design include:

- Static finite slope analysis of proposed cover over FML
- Seismic Newmark sliding block analysis of proposed cover over FML

### Assumption used in the calculations:

- Assumed friction angle of soil on FML = 17°
- Assumed soil internal friction angle = 26°
- Unit weight of the soil = 130 pcf
- Cap slope = 5:1
- Cover thickness = 3.5 ft
- Assumed no cohesion of soil
- Assumed Peak Ground Acceleration (PGA) = .3035 g
- Assume magnitude of earthquake = 6.4

The calculations were performed using guidance found in Koerner, R.M., Designing with Geosynthetics, Second Edition, 1998., and U.S. Geological Survey, Open File Report 03-005, "Java programs for using Newmark's method and simplified decoupled analysis to model slope performance during earthquakes" 2003.

The following calculations show the cover soil has a factor of safety greater than 1.5 (analysis shows FS for Phase 2 cell = 1.59) using a smooth 60-mil HDPE, however a textured HDPE liner will be used in the Phase 2 cell and will most likely provide an even higher factor of safety for static conditions. Calculations also show the cover soil has a factor of safety of 1.53 for seismic conditions which is higher than 1.0, the recommended factor of safety for seismic design.

### **COVERSOIL-DESIGN**

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## Hydrometrics, Inc.

### consulting scientists and engineers

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	3)[cos2(13)[tan (4)(3) sin(113) C > 1.5 OK	05(113)	ssume 90° oil with From Koein	do compaction  do max = 96.9  er for Soil-1  smooth HDDE	e zz. 48 most  ner interface fr  -no available da
			for texture a higher of s	of HDRE WHICH of the lowest of the	GENERAlly has or smooth HDPE

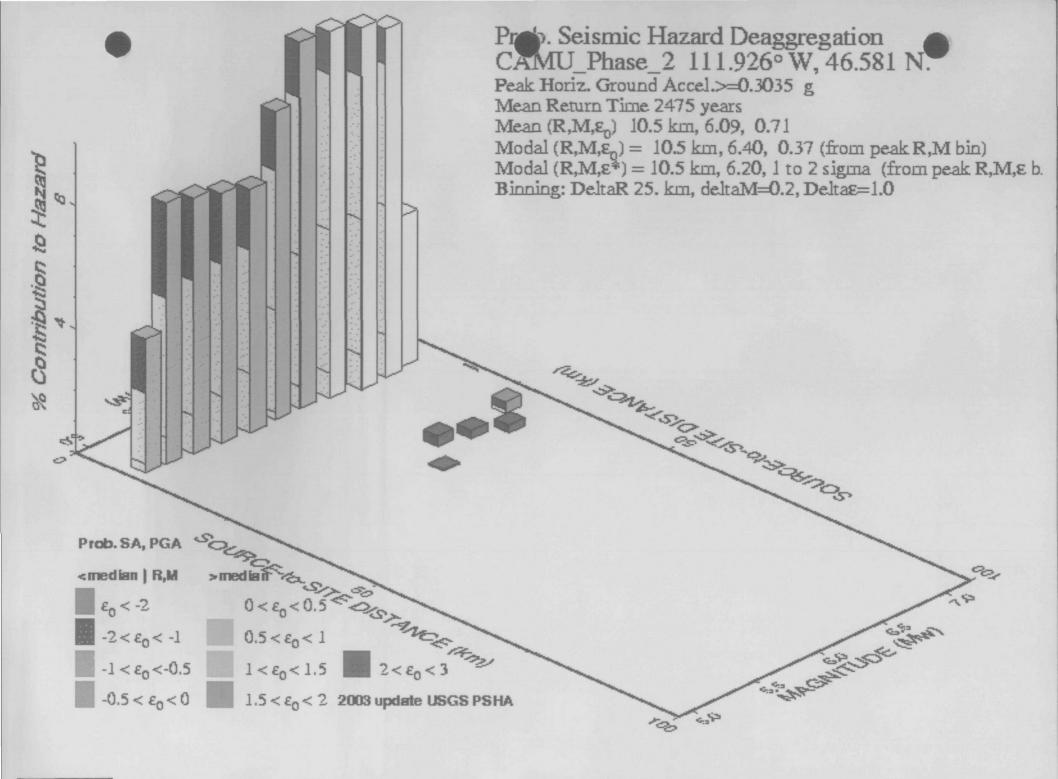
		Digitization		Arias Intensity	Duration (5-95%)	Peak Acceleration	Mean	Epicentral Distance	Focal Distance	Rupture Distance	Focal
Earthquake	Record	Interval (s)	Magnitude	(m/s)	(s)	(g)	Period (s)	(km)	(km)	(km)	Mechanism
Mammoth Lakes-1 1980	MLS-270	0.005	6.3	0.678	7.6	0.321	0.25	12.8	15.6		5
Morgan Hill 1984	AND-250	0.005	6.2	0.683	6.8	0.423	0.43	16.5	18.7	2.6	1
Northridge 1994	ELD-168	0.005	6.7	0.772	7.6	0.363	0.43	40	44	18.3	3
Northridge 1994	ELD-258	0.005	6.7	0.792	8.1	0.352	0.48	40	44	18.3	3
Parkfield 1966	C05-355	0.01	6.1	0.626	7.4	0.367	0.42	32	32	9.3	1
Whittier Narrows 1987	BRD-130	0.005	6	0.417	7	0.313	0.27	23.4	25.3	23.3	5
Whittier Narrows 1987	CAS-000	0.02	6	0.68	8	0.332	0.51	21	23	16.9	5
Whittier Narrows 1987	CAS-270	0.02	6	0.536	8.4	0.333	0.31	21	23	16.9	5
Whittier Narrows 1987	LUR-090	0.005	6	0.747	7	0.36	0.22	9.3	13.3	15.5	5

•

# Color Chart(s)

The following pages contain color that does not appear in the scanned images.

To view the actual images, contact the Region VIII Records Center at (303) 312-6473.



III May 3 20:58



LOCATION 46.58161 Lat. -111.92611 Long.

The interpolated Probabilistic ground motion values, in %g, at the requested point are:

10%PE in 50 yr
PGA 14.72 30.34

1.0 sec SA 34.93 73.34

21.79

Analysis Options page Ground Motion page

### CAMU-NEMARK ANALYSIS USING SCALED PGA OF .3035 g

Mean value is: 1.6 cm Median value is: 1.3 cm Standard Deviation is: 1.0 cm

		Disp1	Disp2	Avg. Disp
Whittier Narrows 1987	BRD-130	0.9	1.6	1.2
Mammoth Lakes-1 1980	MLS-270	0.6	1.2	0.9
Whittier Narrows 1987	CAS-000	3.4	4.5	4.0
Whittier Narrows 1987	CAS-270	0.9	0.8	0.9
Northridge 1994 ELD-25	8	3.8	0.9	2.4
Whittier Narrows 1987	LUR-090	1.0	0.8	0.9
Northridge 1994 ELD-16	8	1.0	1.7	1.4
Parkfield 1966 C05-35		2.1	1.1	1.6
Morgan Hill 1984	AND-250	1.7	0.9	1.3

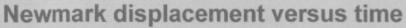
Displacements based on FS calculation for smooth HOPE of 1.53

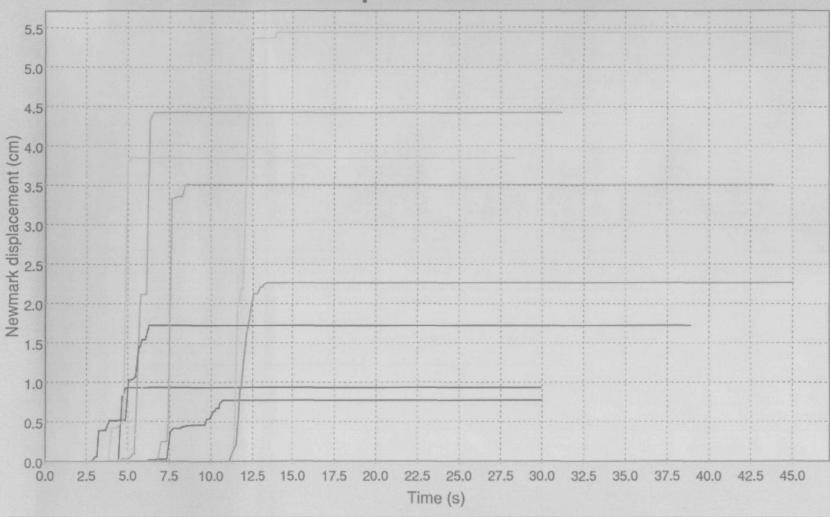
### CAMU NEWMARK ANALYSIS

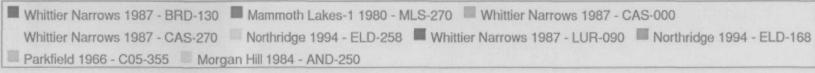
Mean value is: 2.6 cm Median value is: 2.5 cm Standard Deviation is: 1.4 cm

		Displ	Disp2	Avg. Disp
Whittier Narrows 1987	BRD-130	0.9	1.8	1.4
Mammoth Lakes-1 1980	MLS-270	0.8	1.5	1.2
Whittier Narrows 1987	CAS-000	4.4	5.8	5.1
Whittier Narrows 1987	CAS-270	1.2	1.2	1.2
Northridge 1994 ELD-25	8	5.4	1.7	3.6
Whittier Narrows 1987	LUR-090	1.7	1.5	1.6
Northridge 1994 ELD-16	58	2.3	2.7	2.5
Parkfield 1966 C05-35	5	3.5	2.2	2.8
Morgan Hill 1984	AND-250	3.8	3.6	3.7

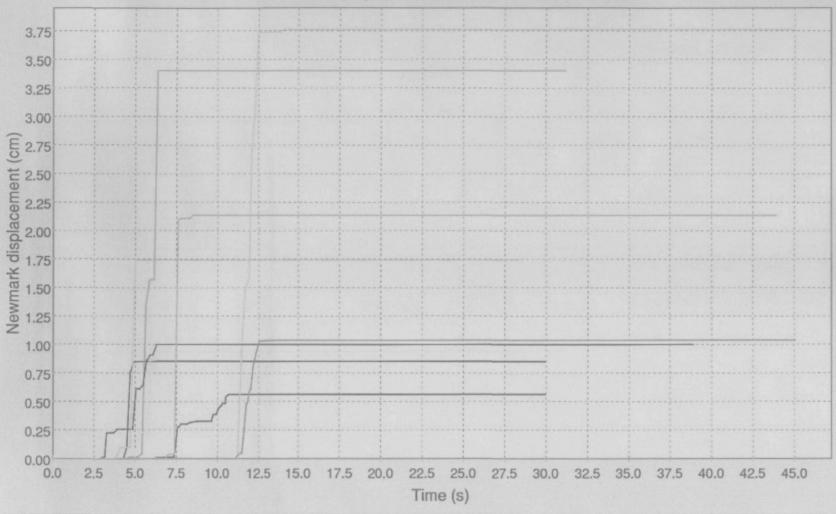
Displacements based on FS calculation for Smooth HDPE of 1.53







### Newmark displacement versus time





### Seismic Analysis of Concrete Sumps

Calculations for the concrete footing in the sumps include:

- Deflection of the footing during an earthquake
- Shear on the footing during an earthquake

### Assumption used in the calculations:

- Assumed unit weight of concrete = 150 pcf
- Assumed effective Peak Ground Acceleration (PGA) = ½\*PGA = .15 g

The following calculations were performed using guidance found in ACI 318-99

The calculations show the functionality of the concrete sump will not be affected during a seismic event.



## **Hydrometrics, Inc.**

### consulting scientists and engineers

Date: 3/20/07	By:	Checked:	Project Number:	6043	Page: 1/2
Defke	ction of Cor	nc. Fasting in			
1 15 - hmin = 1/16	Pipe = 205 /1 30.75 14/FE		as hor	24" HDRE 200/65 pe 10/65/A Utguate A=7752=3.1 62.4 16/63 Winter=195	4 ft <sup>2</sup>
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(bd2) = 1	fy (1-0.59p	(fg/fi)			



# Hydrometrics, Inc. consulting scientists and engineers

Date:	3/20/07	By:	Checked:	Project Number:	6043	Page: 1/2

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### Settlement

Calculations for the cell settlement include:

Amount of anticipated settlement of the cell

Assumption used in the calculations:

- Assumed blow count data from Phase 1 cell was same for Phase 2 cell
- The following calculations show the settlement of the compacted clay liner may range from 1 to 3 inches which is within acceptable limits.

### Settlement

								<del>,</del>		
Settlement	of Landfill			L		L_			ļ	
Pasad on	tondord no	netration te	eting for P		1 Call				ļ	
Daseu on s	stanuaru pe	- I Gu auon te	Sung lor Fr	lase	1 Cell			<del> </del>	<del> </del> -	<del> </del>
B = 455 fee	et > 4 feet	<del> </del>		$\vdash$		<b>!</b> —			<del>                                     </del>	
ρ:	∆q <sub>s</sub> x 12 / (	(N x ((B+1)/	B) <sup>2</sup>							
	$\Delta q_s =$	20	ft x		105	pcf	_	10	ft x	103.0629
	=		psf -	103	30.629					
	=	1069.371								
	Δq <sub>s</sub> =	0.534685	tsf							
ρ:	0.534685	tsf x 12 / (	3.21	×	((	_	455	ft + 1) /	455	$ft)^2$ )
ρ:		inches			.,					
Based on (	Consolidati	on Testing	of Phase 1	Cell						
				<u> </u>		ļ				ļ <u></u>
Δσ =		ft x	124.5 1030.629				10	ft x	103.0629	
=	1459.371	psf -	1030.629	psi		<u> </u>		<u> </u>		<u> </u>
<u> </u>	1409.07 1	psi							<del> </del>	
Borehole	γ <sub>d</sub> (pcf)	e	F.	-	Fo	<u>~.</u>	(psf)	$\sigma_2$ (psf)	Δe	Cc
DOIGHOIG	la (boi)		ε <sub>1</sub>		$\epsilon_2$		(P31)	02 (p3i)		
BH-2	108	0.358974	0.03	<del>                                     </del>	0.057		950	2300	0.027	0.070312
BH-3		0.40349			0.146		950	2300		0.093749
BH-4		0.335233			0.07		950			0.046874
BH-5	96.9	0.424858			0.187		950			0.127603
BH-7	105	0.376781	0.04		0.057		950	2300		
									ļ	
Average		0.379867								0.076562
St Dev 90%		0.035428					2%			0.03487
90%		<b></b>					270			0.12125
n =	H x C <sub>c</sub>	x log	σ <sub>ο</sub> + Δσ							
	(1 + e <sub>o</sub> )	^ 10g								
	(1 + 60)		σ <sub>ο</sub>							
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<u> </u>										
Range of p								·		·
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} <del></del>	(1 +	0.424858		X	iog	103	J.U29	1030.629		hai
<del>                                     </del>	<u>'</u>	J.727000	<del>/</del>					1000.029	P31	
=	0.626883	x log (	2.415999	)				······································		
	0.240157	ft								
=	7	ft x	0.04427		0.02	103	0.629	psf +	1459.371	psf
	(1+	0.335233	)		]			1030.629	psf	
			2-77-22							
	0.232089		2.415999							
_p =	0.088912	ft								
ļ <u>-</u>				in						
p =	1	to	3	inche	ะร		ı			

### Capacity of the Leachate Collection System

Calculations for the capacity of the leachate collection system include:

- Flow capacity of the geocomposite
- Capacity of the sumps

### Assumption used in the calculations:

- Geonet thickness of 250 mil
- Geonet has 8 oz. heat bonded non-woven geotextile on both sides
- Transmissivity of the geonet = 0.2 gal/min/ft

The following calculations show the selected geocomposite has a flow capacity of 79 gal/min and the sumps have a capacity of 36,000 gallons each.

### Capacity of PLCR and LDCR systems

**Effective Cross Sectional Area** 

of each Sump 12.68 ft<sup>2</sup> Length of Sump 379 ft

Total Volume of PLCR  $4805.7 \text{ ft}^3 = 35951.6 \text{ gallons}$ Total Volume of LDCR  $4805.7 \text{ ft}^3 = 35951.6 \text{ gallons}$ 

Maximum leakage rate to the

Sump 0.2 gal/min/ft Transmissivity of Geocomposite Length of Cell 395 ft

Length of Cell 395 Maximum Delivery Rate to

Sump 79 gal/min

### **Liner Leachate Compatibility**

The following documents are liner compatibility information from the liner manufacturer and from the EPA chemical compatibility table for liners that have been referenced in determining the compatibility of the proposed waste to be placed in the Phase 2 cell with the selected HDPE liner. Additional compatibility information was included from testing conducted by the Department of Energy (DOE) for the ICDF Landfill.

### **ATTACHMENT 1**

CHEMICAL RESISTANCE INFORMATION FOR HDPE LINERS

### CHEMICAL COMPATIBILITY OF POLY-FLEX LINERS

Chemical compatibility or resistance as applied to geomembranes is a relative term. Actually compatibility would mean that one material will dissolve in the other such as alcohol in water or grease in gasoline. An example of incompatibility would be oil and water. In liners it is undesirable to have the chemicals dissolve in the liner hence the term compatibility is the reverse of what is normally meant in the chemical industry. In the strictest sense and from a laboratory prospective, chemical compatibility, as the term applies to this industry, would imply that the chemical has no effect on the liner. On the other hand, from an engineering prospective, chemical compatibility means that a liner will survive the exposure to a given chemical even though the chemical could have some effect on the performance of the liner, but not enough to cause failure. Therefore, one must understand and define chemical compatibility for a specific project.

Generally polyethylene will be effected by chemicals in one of three ways.

- No effect—This means that the chemical in question and the polyethylene do not interact. The
  polyethylene does not gain (lose) weight, swell, and the physical properties are not significantly
  altered.
- Oxidizes (cross linking)—Chemicals classed as oxidizing agents will cause the polyethylene molecules to cross link and cause irreversible changes to the physical properties of the liner. Basically it makes the liner brittle.
- 3. Plasticizes—Chemicals in this classification are soluble in the polyethylene structure. They do not change the structure of the polyethylene itself but will act as a plasticizer. In doing so, the liner will experience weight gain of 3-15%, may swell by up to 10%, and will have measurable changes in physical properties (i.e. the tensile strength at yield may decrease by up to 20%). Even under these conditions the liner will maintain its integrity and will not be breached by liquids, provided the liner has not been subjected to any stress. These effects are reversible once the chemicals are removed and the liner has time to dry out.

Aside from the effect that chemicals have on a liner is the issue of vapor permeation through the liner. Vapor permeation is molecular diffusion of chemicals through the liner. Vapor transmission for a given chemical is dependent primarily on liner type, contact time, chemical solubility, temperature, thickness, and concentration gradient, but not on hydraulic head or pressure. Transmission through the liner can occur in as little as 1-2 days. Normally, a small amount of chemical is transmitted. Generally HDPE has the lowest permeation rate of the liners that are commercially available.

As stated above chemical compatibility is a relative term. For example, the use of HDPE as a primary containment of chlorinated hydrocarbons at a concentration of 100% may not be recommended, but it may be acceptable at 0.1% concentration for a limited time period or may be acceptable for secondary containment. Factors that go into assessment of chemical compatibility are type of chemical(s), concentration, temperature and the type of application. No hard and fast rules are available to make decisions on chemical compatibility. Even the EPA 9090 test is just a method to generate data so that an opinion on chemical compatibility can be more reliably reached.

A simplified table on chemical resistance is provided to act as a screening process for chemical containment applications.

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### **CHEMICAL RESISTANCE INFORMATION**

CHEMICAL CLASS	CHEMICAL EFFECT		ONTAINMENT IM CONTACT) LLDPE		CONTAINMENT RM CONTACT) LLDPE
CARBOXYLIC ACID  - Unsubstituted (e.g. Acetic acid)  - Substituted (e.g. Lactic acid)  - Aromatic (e.g. Benzoic acid)	1	8 A A	C B B	A A A	C A A
ALDEHYDES - Aliphatic (e.g. Acetaldehyde) - Hetrocyclic (e.g. Furfural)	3	B C	C	B B	C
AMINE - Primary (e.g. Ethylamine) - Secondary (e.g. Diethylamine) - Aromatic (e.g. Aniline)	3	В С В	000	8 8 8	ccc
CYANIDES (e.g. Sodium Cyanide)	1	Α	A	Α	Α
ESTER (e.g. Ethyl acetate)	3	В	С	В	С
ETHER (e.g. Ethyl ether)		С	С	В	С
HYDROCARBONS - Aliphatic (e.g. Hexane) - Aromatic (e.g. Benzene) - Mixed (e.g. Crude oil)	3	CCC	ccc	B B B	c c c
HALOGENATED HYDROCARBONS - Aliphatic (e.g. Dichloroethane) +A4 - Aromatic (e.g. Chlorobenzene)	3	C C	c c	В В	c c
ALCOHOLS - Aliphatic (e.g. Ethyl alcohol) - Aromatic (e.g. Phenol)	1	A A	A C	A A	A B
INORGANIC ACID  - Non-Oxidizers (e.g. Hydrocloric acid)  - Oxidizers (e.g. Nitric Acid)	1 2	A C	A C	A B	A C
INORGANIC BASES (e.g. Sodium hydroxide)	1	Α	Α	Α	Α
SALTS (e.g. Calcium chloride)	1	Α	Α	А	Α
METALS (e.g. Cadmium)	1	Α	Ā	A	Α
KETONES (e.g. Methyl ethyl ketone)	3	С	C	В	С
OXIDIZERS (e.g. Hydrogen Peroxide)	2	С	С	С	С
The state of the s					

Chemical effect (see discussion on Chemical Resistance)

http://www.poly-flex.com/printpg/rfcr.html

5/2/2007

<sup>1.</sup> No Effect-Most chemicals of this class have no or minor effect.

- 2. Oxidizer-Chemicals of this class will cause irreversible degradation.
- 3. Plasticizer-Chemicals of this class will cause a reversible change in physical properties.

#### Chart Rating

- A. Most chemicals of this class have little or no effect on the liner.

  Recommended regardless of concentration or temperature (below 150°F).
- B. Chemicals of this class will effect the liner to various degrees. Recommendations are based on the specific chemical, concentration and temperature. Consult with Poly-Flex, Inc.
- C. Chemicals of this class at high concentrations will have significant effect on the physical properties of the liner. Generally not recommended but may be acceptable at low concentrations and with special design considerations. Consult with Poly-Flex, Inc.

This data is provided for informational purposes only and is not intended as a warranty or guarantee. PolyFlex, Inc. assumes no responsibility in connection with the use of this data. Consult with PolyFlex, Inc. for specific chemical resistance information and liner selection.

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### **ATTACHMENT 2**

CHEMICAL COMPATABILITY TABLE FOR NON AQUEOUS PHASE LIQUIDS

(Source: EPA Groundwater Issue, EPA/540/S-95/503, July 1995)

### CHEMICAL COMPATIBILITY TABLE

#### For All Non-Metals

R = Resistant A = Excellent - No effect B = Good - Minor effect

C = Fair - Moderate effect U = Unsatisfactory X = Conflicting Data - = No Data Available

#### For Metals

E < 2 mils Penetration/Year G < 20 mils Penetration/Year S < 50 mils Penetration/Year U > 50 mils Penetration/Year

(1 mll = .001 inch)
A = Excellent - No effect\*
B = Good - Minor effect\*

 				C = Fair - * No comi					
	Plasti	cs	Elastopolymers				Me	tals	3
elrin)	92	rlene flon) a II mar)	na-N ane		less	less	teel	ပု	_

	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypropylene	PTFE (Teffon)	PVC Type I	PVC Type II	PVDF (Kynar)	EPDM	Kal-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper	
Acetaidehyde	U	A	U	RUUAAUUX AACUUAUU - REE		E	G	Ę	G	U	U																		
Acetemide	۱-	Α	•	R	R	R	A	A	U	-	С	A	Α	8	A	U	В	U	В	•	•	1 -	в	-	-	G	-	•	ı
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				ì	Plas	stic	\$							E	las	to	ool	/me	ers						M	etal	s		
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	HDPE	Polypopoylene	PTFE (Tellon)	DVC Type I	DVC Tope II	PVC Ighan	rvor (Aynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Butylacetate Butyric Acid Carbon Tetrachloride Carbonic Acid Chloroacetic Acid Cresylic Acid 50% Crude Oli Cyclohexane Cyclohexane Cyclohexane Cyclohexane Cyclohexane DDT 5% Detargents (general) Disoacetic Acid District Phihalate Dichloroacetice Dimethyl Ether Dimethyl Ether Dimethyl Ether Dimethyl Ether Dimethyl Ether Dimethyl Formamide Dimethyl Fo	U	AABBUX - AA - RBUURAA - AA - A - A - BR - AU - X - R R - U - AUAAAR - R	XUUAUUUGUURUUBAUUUUA.UU.AU.U.U.U.UU.AUUUB.UU	我我只说说话,一只说,我就我就会说话,我就就就就是我们的我们,我们就是一个,我们就是一种,我们就是一个,我们就是我们就是一个,我们就是我们就是一个,我们就是我们就是我们就是我们就是我们就是我们就是我们就是我们就是我们就是我们就是	R-RUBERR	_	XRUACUA - XX AUXRUU - ARRCXR - ARAR - AX - ARR- URUU - UXUAAUBU	ARRAABARAA - RARRUAA - AARAARRARXARAARX RRRRRRAARAAAA ARAR	U		BARAAA AA - RARRURR - AAU AAR - AUXR - AA - URU - RU - BRAXRXRRUR		.UXUUB.AARUUU.U.9J.A3.CJR3JJ.)1331.L.	<b>A</b> B	BU - 8 BUUAUU	U	U			UBAAUAAABAAXARAU.AUUCCR.A.AU.AU.XR.XRUAA.AUXUARAB		RRR. "R" RR	GGEGUG. GGEEGEGGEEGG. GG. EEGG. E8G. E. GGGGB. AEEGGB. E	COECUC. COECGECCECCECCCCCC. EEGC. EEGCE. CCCCACAEEGCC. E	© 10 0 0 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ECUEUC · · · GU · EGGEGEGEGEGGGG. EEGG, GA · EE · · EGGB · · GG · EG ·	G G G G U G B G G G G . G E G . G E G	GOEGUG GG

				i	Plat	stic	5						J	Elas	sto	poły	/me	13						Me	tal	s		
	ABS	Acetal (Deirln)	CPVC	FEP	Nylon 6, 68		Polypropylene	PTFE (Teflon)	PVC Type	PVC Type II	PVDF (Kynar)	EPDM	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Тудоп	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Conner
Ethyl Sutfate Ethylene Bromide Ethylene Chlorohydrin Ethylene Chlorohydrin Ethylene Obbromide Gasoline (ligh-aromatic) Gasoline (ligh-aromatic) Gasoline (ligh-aromatic) Gasoline (ligh-aromatic) Gasoline (unleaded) Glycolic Acid Heptane Hexachlorosthane Hexamine Hexamine Hexamine Hexamine Hexamine Hexamine Hexamine Hexamine Hexamine Hydragen Peroxide (ditute) Hydrazine Hydrogen Peroxide (ditute) Hydrazinone Hydrogeninone Lacquer thinnens	U	AUX-BUAAUABAAAAAAB-BRAA-A-UAU-AAUUBBBBAAAAXUBAAUUU	· UUUU - AXAAR - AUXAA B UUAA UCR - RR AAARA - U AA - U -	R . R R R	AARRUXXARRA - RB - U	- R B -	RUUBABRAAX. BAAA		U R U U - R - U U		- AAABRAAAABAAABA A . AAARRAC - AXRXAAA - UBAAAA - ABUBAACAU	- XXBA - AXAARUUUUAU UCUAARUAAAUBAU , UUUUAAUXUAXXABAAAUA	ABA.U.ACAA.AAABAA	- XUXX - AUCBRBABBAB BAAABUAAAABUBUUUAUUAAUUXUBXUBAA - UU	UUAABB	- RR.U R UR UU	.UVAUVBBBBAUVAU-VJJJJAAB.3CJJ-JAAL-	CAB - UAAA CAA - AA - AULAABACAU AA - III		A A	R	G	DEGGGGGAEEGAGGGGEEAAAAGG . E . AGGG . GGGEGGGEUEGA . G . AGA		, E . GUGEEAGEGAEEGEGEAAA . EG . U GG EG GGGGG . EE E	E G A G	-	E . C.C.U. G . AGEG. GG AAAU G GG GGU. U. G G.

				F	Plas	stic	s							Ela	sto	po	lyn	ers						Me	etal	S		
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66	•	Polypropylene	PTFE (Teflon)	PVC Type 1	DVC Type II	PVDE (Kynar)	FPDM	Kel-F	Acaracan	Nitrilo Bridge N		Polyurethane	Types	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Methyl Chlorida Methyl Chloroform Methyl Dichloride Methyl Ethyl Kelona Methyl Isopropyl Ketona Methyl Methacrylala Methyl Pentanona Methyl Pentanona Methylena Chlorida Monochloroacatic acid	υυ.υυυ. -	8 - U U - B U	U U - U - R U U -	R R - R - R R R -	R CRA RUU	U U R U U	U U B - X R B -	AR - AARAAA	U U . U U R U U .	υυ - υ - υ υ υ -	A R U U - B X B B	UUUACUBXC	A	. U U U U A	. U U U U U U U U U U U U U U U U U U U			U U U -	A R A U U U U B C	- A	R	E . G A G G G A	E - G A G G G A	u	G	U	E	G G A . G G
Monoethanolamina Motor Oil Naphalene Nitrobenzene Nitromethane Nitrophanol Octane Octyl Alcohol Otelc Acid Oxalic Acid 5% Palmitic Acid 10%	. CUUU AXRA	U B X X A A A U A	- A U U U B A R A	R R R R R R R R R R R R R R	RRRRU - ARUR	. UUU R . URR	8 U R B R . R . B R B	A A A A R R . A R A	URUUR, U.RRR	URUUR.U.RRR	U B A A A . R . A R A	80008.08888	. A A A	X B U U U . R B X R U	BAUUU RBBUA	RU R . R	U U	- A C U B C - B	XRABU.RBBRA	. A A A	R	EGEGGG . AEU .	EGEGGGAEGG		6.66	G . G E G G G A G G G	6666.66886	6666.664666
Pentachiorophenol Pentane Petroleum Phenol 10% Phthalic Acid Phthalic Anhydride Picric Acid Propyl Alcohol Propytene	- B U B B X X B B	- BBXCCAA	A A X U U A	R R R R R	. A . UR . UU . B	UR UR	A A	RAAAAAAA	- ARUUUURB!			·UUBAAAU	В - - А	- B B U A A A U C	- A A U U U X A U		. U U U B . B A U	А. С. В. АВ	R A A A A A A A A	A A .	R	. C C C C E C E B C	CGGEEGEAC	E 0 S G U G - 0	. A . G G E G E . C	BGEGEGA		
Propylene Glycol Propylene Oxide Pyridine Sodium Acetate Sodium Benzoeta Sodium Hypochlonte 20% Stearic Acid Styrene Tertaric Acid Tetrachloroacetic Acid	В В A R U R	B - B B - U A A 8 -	X - U A A R B U A R	R R R R R R R R	R - RRRURABR		RAAARA .	R A A	R R U A	UUURRRRR	AUUAARA-BR	ARXAARXUBU	A A A A .	CUUBAUBUAR	AUUBBUBUAR	· · · · · · · · · · · · · · · · · · ·	A - U U - B B U A -	U . B C B . B .	A U U U A A A B A R	A . A A A .	UR	G E G G . U G A C E	GEGG. UEACE	G . G U . U s	G - E G G U E U B G	G G A B	G - G G - G S A U S	G - G G E S G B A U
Tetrachioroethane Tetrachioroethylene Tetrachiorophenol Tetraethyl Lead Tetrahydrofuran Toluene Toxiphane-Xylene 10-80% Trichioroacetic Acid Trichiorobenzene	. ט. טטט	A A A X	XU. RUUUR.	RR. RRRRR.	R R - R R	บ บ บ บ	CUR I	A A R A A A A	00 - R 0 0 0 0 0	บบ. R บบ.	A R R B A - B -	00.000.B.	A A A B . A .	מסיים מסיים			00		AA.RXG.CR	A A . A .	R	EE, GEEGU.	EE.GGEGU.	EG.GEESUE	EG EE . G .	G	G G	S G E - G
Trichloroethane Trichloroethylene Trichlorofluoromethane Trichlorofluoromethane	U	A U A	U -	R	R		c /		Ç	U -	A B	ບ ປ	A A	UUUA	טטטט	u	U U -	U	A X - A	A -		G A	G G A	G -	•	E G	G -	G

				F	Plas	stic	\$						E	Elas	top	юly	me	rs						Me	etal	S		
	ABS	Acetal (Delrin)	CPVC	FEP	Nylon 6, 66		Polypropylene	PTFE (Tellon)	PVC Type I	PVC Type II	PVDF (Kynar)	ЕРОМ	Kel-F	Neoprene	Nitrile Buna-N	Polyurethane	Silicone	Tygon	Viton-A	Ceramic	Silica	304 Stainless	316 Stainless	Carbon Steel	Hastelloy-C	Aluminum	Brass	Copper
Triethanolamine	R	U	R	R	R	U	R	R	U	IJ	R	R		R	u	υ	_	-	R	-		G	G	G	G	G	U	E
Triethylamine	U	U	Α	R	R		U	Α	R	R	A	A	Α	Α	¢	-	-	Α	x	8	_	G	G	-	-	-		
Trimethylpropane	Įυ	-	R	R	-	-	υ	R	R	R	R	١.	-	-	R	R	-	•	- 1		-	-	•	-	-	-	-	-
Turpentine	υ	A	Α	R	R	U	Х	Α	X	U	Α	U	Α	U	R	U	U	В	ΑÍ	A	-	E	E	G	G	G	s	G
Vinyi Acetate	υ	-	υ	R	-	U	8	Α	บ	U	A	В	-	×	х	-	U	Ų	A	В	-	Ε	E	G	E	E	G	-
Vinyl Chloride	U	-	u	-	Α		-	A	U	-	В	C	-	U	υ	-	-	IJ	A	Α	-	8	Α	-	Α	8	-	В
White liquor (Pulp mill)	X	U	R	R	R	-	R	R	R	R	R	R	-	R	R	-	-	-	R	-	-	G	G	S	G	G	•	•
White Water (Paper mill)	R	В	-	-	R	-	R	-	R	-	-	-	-	A	•	-	-	-	A	-	-	٨	A	•	-	-	-	-
Xylene	U	A	U	R	R	U	В	Α	U	U	Α	U	Α	U	U	U	U	U	хI	Α		G	G	G	E	G	G	G

This table should only be used as a guide since it is difficult to duplicate operating conditions. To fully guarantee the sultability of a particular material, chemical resistance tests should be conducted under actual operating conditions.

No data was found on the following environmentally important chemicals:

Acenaphthene (1)
Acenaphthalene (1)
Acrolein
Anthracene (1)
Benzidine
Benzo(a)athracene (1)
Benzo(b)fluoranthene (1)
Benzo(a)pyrene (1)
Bromophenylphenylether
Butylbenzylphthalate
Chloroethyomethane
Chloroethylether
Chloroethylether
Chloroethylythylether
Chloroethylythylether

Chloromathylether
Chlorophenyiphenylether
Chrysene (\*)
DDD (\*)
DDE (\*)
Dichlorobenzidine
Dichlorobromomethane
Dichlorophenol
Dichlorophenoxyacetic acid
Dichloropropane
Dichloropropylene
Dieldrin (\*)
Dintrophenol
Diphenylhydrazine
Endosulfan
Endrin (\*)

Fluoranthene (\*)
Fluorene (\*)
Heptachior (\*)
Hexachiorobenzene
Hexachiorobutadiene
Hexachiorocyciohexane
Indeno (1,2,3-c,d)pyrene (\*)
Isophorone
2-Methylnapthalene
Parachiorometa cresol
Phenanthrene (\*)
Phenylenepyrene
Pyrene (\*)
Trichlorophenol
Trichlorophenoxyacetic acid

<sup>(1)</sup> Component of cresotoe and coal tar. At room temperature and below, these compounds are solid in pure form.

<sup>@</sup> Pesticides

### **ATTACHMENT 3**

LINER COMPATABILITY TESTING CONDUCTED

BY THE DEPARTMENT OF ENERGY



### Department of Energy

Idaho Operations Office 1955 Fremont Avenue Idaho Falls, ID 83401

April 26, 2005

Nicholas Ceto, INEEL Project Manager EPA Region 10 309 Bradley Landing, Suite 115 Richland, WA 99352

Daryl F. Koch, Remediation Manager Waste and Remediation Division Idaho Department of Environmental Quality 1410 North Hilton Boise, Idaho 83706-1255

SUBJECT: Transmittal of Request to Change the Existing PM-2A V-14 Staging Area to Temporary Unit and Proposed New Constituents for ICDF Landfill and Evaporation Pond Waste Acceptance Criteria (FMDP-RFDP-05-024)

Dear Mr. Ceto and Mr. Koch:

1

This letter transmits a request for a change in designation for the existing PM-2A V-14 tank storage area and also the proposed new constituents for addition to the ICDF Complex Waste Acceptance Criteria.

The first attachment is a request for a change in designation of the existing PM-2A V-14 tank storage area near the INL CERCLA Disposal Facility (ICDF) evaporation ponds from a staging area to a temporary unit. The attached drawing identifies the area for change just north of the evaporation ponds. This is needed to allow treatment of the contents of this tank prior to final disposal into the ICDF landfill. Upon your review and concurrence the Staging Area designation will be changed.

The second attachment includes the proposed new constituents for addition to the ICDF Complex Waste Acceptance Criteria (WAC). The new constituents were identified in the semiannual data call submitted by all the Waste Area Groups (WAGs). Upon your review and approval the new constituents will be updated into the respective WACs.

If you have questions regarding either attachments, please contact me at 208-526-7001 or verwolmc@id.doe.gov.

Sincerely,

Pary C Verwoff Mary C. Verwolf

ICDF Project Manager

**Environmental Restoration Program** 

#### **Enclosures**

cc: M. Spomer, Idaho Department of Environmental Quality, 1410 N. Hilton, Boise, ID 83706

D. Einan, EPA Region X, 309 Bradley Landing, Suite 115, Richland, WA 99352

UFC: 6102.RFDP.313 FMDP-RFDP-05-024

EXTERNAL bcc DISTRIBUTION: ARDC, BBWI, MS3922, w/o enc. Jack Simonds, MS 3950, w/o enc.

M. Heileson, MS 3950, w/o enc.

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M. Verwolf, MS 4149, w/ enc.
K. Hain, MS 1222, w/o enc.
A. Kraupp, MS 1226, w/o enc.

CONCURRENC	<u>E</u> :

#### **RECORD NOTES:**

- This letter transmitted the Request to Change the Existing PM-2A V-14 Staging Area to Treatment Unit and Proposed New Constituents for ICDF Complex to EPA and IDEQ.
- 2. This letter was written by Mary C Verwolf

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- 3. This letter/memo closes OATS number N/A
- 4. The attached correspondence has no relation to the Naval Nuclear Propulsion Program.

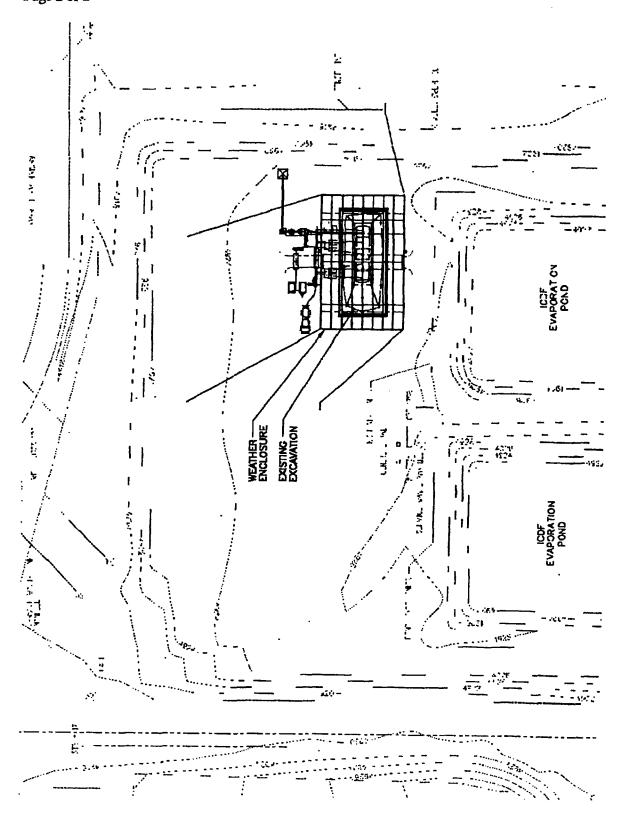
[Author] [Acronym for the AM/DIR] Mary C Verwolf, 6-7001, April 26, 2005, O:\NE-ID\EM-ICP\FMDP\RFDP\RFDP\letters 2005\FMDP-RFDP-05-024.doc

Attachment 1 April 25, 2005 CCN 55557 Page 1 of 2

40 CFR 264.553 (C) In establishing standards to be applied to a temporary unit, the Regional Administrator shall consider the following factors:

- (1) Length of time such unit will be in operation; January to September 30, 2005
- (2) Type of unit; CERCLA storage and treatment
- (3) Volumes of waste to be managed; V-14 contents (approximately 46,000 lbs.)
- (4) Physical and Chemical Characteristics of the wastes to be managed in the unit: 20 to 25 weight percent diatomaceous earth, 20 to 25 percent dark wet sludge, and 50-60 percent water. F001 Tetrachloroethylene that will be reduced through treatment from approximately 100-100 mg/kg to less than 6 mg/kg.
- (5) Potential for releases from the unit: Residue will be treated in the tank via air sparging and the off gas will be filtered through granular activated carbon to remove volatilized organic constituents (primarily tetrachloroethylene). Then the treated contents will be solidified. The tank is adequate containment but is also contained within an impermeable secondary containment system to prevent the release of waste materials.
- (6) Hydro geologic and other relevant environmental conditions at the facility which may influence the migration of any potential releases; None, the tank is placed in a lined depression on a man made soil berm next to the ICDF Evaporation ponds.
- (7) Potential for exposure of humans and environmental receptors if releases were to occur from the unit. The enclosure for the tank is located within the AOC for OU 3-13 on the INL. Public access is limited and only trained workers are allowed access within the area during the treatment process. Potential for exposure during the treatment process is controlled by the filtration and treatment process design to limit the increase in exposure potential to be within the approved risk basis for the existing CERCLA facility.

Attachment 1 April 25, 2005 CCN 55557 Page 2 of 2



Attachment 2 April 25, 2005 CCN 55557 Page 1 of 6

#### ICDF-WAC Recommendations - April 2005

Prepared for: ICDF Implementation Project

Prepared by: BBWI, James M. McCarthy and Paul Ritter

Date: April 13, 2005

The purpose of this report is to present waste acceptance criteria (WAC) for several constituents that may be placed in the Idaho CERCLA Disposal Facility (ICDF) landfill and evaporation ponds. The constituents to be considered are listed in Table A. The generators reported the soil concentration shown in Table A. Although the soil concentrations are listed as the design inventory in other tables of this report, the concentrations are generally the same as the RCRA treatment standards found in the table of universal treatment standards (40CFR 268.48).

Table A. List of constituents requested for WAC calculation.

Constituent	CAS#	Soil Concentration Reported by the Generators
		(mg/kg)
Carbon Tetrachloride	56-23-5	6
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	<b>30</b> · ·
Chloroform .	67-66-3	6
PCBs	1336-36-3	10
Trichlorofluoromethane	75-69-4	30
Pyridine	110-86-1	16
Bromoform	75-25-2	15
Trans-Acetylene Dichloride (1,2-Dichloroethene) <sup>a</sup>	156-60-5	30
Ether (ethyl ether)	60-29-7	160
m-Cresol (mixed isomers) <sup>b</sup>	108-39-4	5.6
Creosote oil	8001-58-9	6
Methanol (methyl alcohol)	67-56-1	1

a. There is a current WAC for 1,2-dichloroethene of 0.32 mg/kg. The current WAC was set to 1,000 the design inventory identified when the WAC was developed. Since this is not a performance based WAC value, the WAC is being updated.
 b. Only m-cresol is not listed in WAC

#### A. BACKGROUND

The INEEL is disposing of remediation wastes at the ICDF and planned disposals have identified constituents that were not included in the original WAC and constituents for which the waste has soil concentrations greater than the original WAC. Since for many constituents, the WAC was simply set to 1000 times the original design soil concentration, a reevaluation is needed to calculate a WAC based on the predicted leachate and future peak groundwater concentrations.

#### B. METHODOLOGY

The WAC formulation processes are described in DOE/ID-10865, "Waste Acceptance Criteria for the ICDF Landfill and DOE/ID-10866, "Waste Acceptance Criteria for ICDF Evaporation Pond" were followed to establish WAC limits.

#### C. RESULTS AND DISCUSSION

Based on the documentation in DOE/10865 and DOE/ID-10866 tables were identified that need to be updated with the new constituents or new soil concentration estimates. The results are presented in the next two sections.

### D. DOE/ID-10865, "WASTE ACCEPTANCE CRITERIA FOR ICDF LANDFILL"

DOE/ID-10865, "Waste Acceptance Criteria for ICDF Landfill" including the main document and appendices should be amended with the following tables.

Table 3-3. in REV 7 and Table 5-2. ICDF Landfill Waste Acceptance Criteria

Constituent	Selected WAC Concentration Guideline (mg/kg)	Landfili WAC Maximum Mass <sup>a</sup> (kg)	Source of WAC Concentration Guideline
Carbon Tetrachloride	500	3.79E+05	Regulatory Limit
1,1,2-Trichloro-1,2,2-trifluoroethane	100,000	7.59E+07	Regulatory Limit
Chloroform	285	2.16E+05	Liner Compatibility
PCBs	500	3.79E+05	Regulatory Limit
Prichlorofluoromethane	500	3.79E+05	Regulatory Limit
Pyridine	500	3.79E+05	Regulatory Limit
Bromoform	500	3.79E+05	Regulatory Limit
Frans-Acetylene Dichloride (1,2-Dichloroethene)	500	3.79E+05	Regulatory Limit
Ether (ethyl ether)	· 358	2.72E+05	Liner Compatibility
n-Cresol (mixed isomers)	100,000	7.59E+07	Regulatory Limit
Crecotote oil	31,587	2.40E+07	Liner Compatibility
Methanol (methyl alcohol)	500	3.79E+05	Regulatory Limit

a. From soil conc.(mg/kg) WAC (Table D-1) \* bulk density (1946 Kg/m^3) \* total KDF soil volume (389,923 m^3)/1E6 mg/kg)

b. There is a current WAC for 1,2-dichloroethene of 0.32 mg/kg. The current WAC was set to 1,000 the design inventory identified when the WAC was developed. Since this is not a performance based WAC value, the WAC is being updated.

Attachment 2 April 25, 2005 CCN 55557 Page 3 of 6

Table A-2. Selected Allowable Waste Soil Concentrations Based on RAOs.

Constituent	Type	Design Invento Concentration (pCl/kg or mg/k	BAGe in 15408 we *	Basis for Adjusted Maximum inventory
Carbon Tetrachloride	Volatile Organic	6	No Limit	Decays before reaching aquifer
1,1,2-Trichloro-1,2,2-trifluoroethane	Organic	30	No Limit	Decays before reaching aquifer
Chloroform	Volatile Organic	6	No Limit	Decays before reaching aquifer
PCBs	PCB	10	No Limit	Decays before reaching aquifer
Trichlorofluoromethane	Volatile Organic	30	No Limit	Decays before reaching aquifer
Pyridine	Volatile Organic	16	No Limit	Decays before reaching aquifer
Bromoform Trans-Acetylene Dichloride (1,2-	Volatile Organic	15	No Limit	Decays before reaching aquifer
Dichloroethene)	Volatile Organic	30	No Limit	Decays before reaching aquifer
Ether (ethyl ether)	Volatile Organic	160	No Limit	Decays before reaching aquifer
m-Creso) (mixed isomers)	Organic	5.6	No Limit	Decays before reaching aquifer
Creosote oil	Organic	10,000	No Limit	Decays before reaching aquifer
Methanol (methyl alcohol)	Volatile Organic	1	No Limit	Decays before reaching aquifer
constituent is not on the list, it is defined as a VCC h. The constituents are all predicted to decay compactualisms. The predicted water travel time to the Carbon Tetrachloride 1,1,2-Trichloro-1,2,2-trifleoroethium (Freon-113) Chloroform PCBs Trichlororfseconnechase Prysidine Brossoform	olesaly in the ICDF landful	med vadore zone, during tr he contestiment half lives at 1 yr 2 yr 5 yr 0.5 yr 2 yr 0.04 yr 1 yr	he table in 40 CFR 265 Appendix VI is used to define temport to the aquifer. The following see the biodegram as follows:	
Trans-Acetyless Dichloride (1,2-Dichlorosthene) Ether (ethyl other)		1.1 yr 100 yr Nodd	sa conservative estimate	
no-Cresol (mixed isomers) Crescots oil Methenol (methyl alcohol)		0.13 yr	EX COORCEVISIVE estimate	

Attachment 2 April 25, 2005 CCN 55557 Page 4 of 6

Table B-1. Maximum Allowable Concentration in Soil for Liner Compatibility

Constituents	Average Leachate Concentration', C <sub>Unit</sub> (mg/L)	Design Inventory Concentration in Soil, Cast (mg/kg)	Waste Soil to Leachate Ratio, Can/Clipte (L/kg)	Max Concentration Allowed in Leachate for Compatibility (mg/L)	Maximum Allowable Concentration in Soil For Compatibility * (mg/kg)
Carbon Tetrachloride	2.80	6	2.14	2,000	4.29E+03
1,1,2-Trichloro-1,2,2-trifluoroethane	1.53	30	19.7	500,000	9.83E+06 (No Limit)
Chloroform	42	6	0.14	2,000	2.85E+02
PCBs	0.00032	10	31,193	2,000	6.24E+07 (No Limit)
Trichlorofluoromethane	96	30	0.31	2,000	6.27E+02
Pyridine	1.03	16	15.6	100,000	1.56E+06 (No Limit)
Bromoform	24.04	15	0.62	2,000	1.25E+03
Trans-Acetylene Dichloride (1,2-Dichloroethene)	47	30	0.64	2,000	1.27E+03
Ether (ethyl ether)	894	160	0.18	2,000	3.58E+02
m-Cresol (mixed isomers)	1.20	6	4.66	100,000	4.66E+05
Creasate ail	158,295	10,000	0.063	500,000	3.16E+04
Methanol (methyl alcohol)	0.031	í	32.4	500,000	1.62E+07 (No Limit)

a. If the maximum allowable concentration were greater than 1E6 mg/kg or 1kg/kg then the KDF liner would be compatible with the entire KDF filled with that constituent. Therefore there is no limit.

Table D-1. WAC Concentration Selection

Constituent	Groundwater RAO Guidance Concentration a (mg/kg)	Liner Compatibility <sup>b</sup> (mg/kg)	Regulatory Limitation * (mg/kg)	Background <sup>d</sup> (mg/kg)	Selected WAC Concentration (mg/kg)	Source of WAC Concentration
Carbon Tetrachloride	No Limit	4,288	500	NA	500	Regulatory Limit
1,1,2-Trichloro-1,2,2-trifluoroethane	No Limit	No Limit	100,000	NA	100,000	Regulatory Limit
Chloroform	No Limit	285	500	NA	285	Liner Compatibility
PCBs	No Limit	No Limit	500	NA	500	Regulatory Limit
Trichlorofluoromethane	No Limit	627	500	NA	500	Regulatory Limit
Pyridine	No Limit	No Limit	500	NA	500	Regulatory Limit
Bromoform	No Limit	1,248	500	NA	500	Regulatory Limit
Trans-Acetylene Dichloride (1,2-Dichloroethene)	No Limit	1,270	500	NA	500	Regulatory Limit
Ether (ethyl ether)	No Limit	358	500	NA	358	Liner Compatibility
m-Cresol (mixed isomers)	No Limit	465,547	100,000	NA	100,000	Regulatory Limit
Creasate oil	No Limit	87 <b>ح.</b> 31	100,000	NA	31,587	Liner Compatibility
Methanol (methyl alcohol)	No Limit	No Limit	500	NA	500	Regulatory Limit

a. From Table A-2 in the ICDF Landfill WAC.

b. Prom last column of Table B-1, "Maximum Allowable Concentration in Soil for Compatibility"

c. Total organic constituents cannot exceed 10% by weight (100,000 mg/kg) per 40 CFR 264.1050(f), total volatile organic constituents cannot exceed 500 ppm per 40 CFR 264.108(c)(1). And Total PCBs cannot exceed 500 mg/kg (40 CFR 761.60).

d. No organic background expected.

Attachment 2 April 25, 2005 CCN 55557 Page 5 of 6

Table F-1. Comparison of Design Inventory and Waste Acceptance Criteria Concentrations.

Constituent	Design inventory (DI)  Mass or Activity *  (kg)	Waste Acceptance Criteria (WAC) Mass or Activity b (kg)	Mass or Activity Comparison (DVWAC) %
Carbon Tetrachloride	4.55B+03	3.79E+05	1.2%
1,1,2-Trichloro-1,2,2-trifluoroethane	2.28E+04	7.59E+07	0.0%
Chloroform	4.55E+03	2.16E+05	2.1%
PCBs	7.59B+03	3.79E+05	2.0%
Trichlorofluoromethane	2.28E+04	3.79E+05	6.0%
Pyridine	1.21E+04	3.79E+05	3.20%
Bromoform	1.14E+04	3.79E+05	3.0%
Trans-Acetylene Dichloride (1,2-Dichloroethene)	2.28E+04	3.79E+05	6.0%
Ether (ethyl ether)	1.21E+05	2.72E+05	45%
m-Cresol (mixed isomers)	4.25E+03	7.59B+07	0.01%
Creosote oil	7.59E+06	2.40E+07	32%
Methapol (methyl alcohol)	7.59E+02	3.79B+05	0.20%

a. From design inventory soil conc.(mg/kg) (Table A-2) \* bulk density (1946 Kg/m^3) \* total KDF soil volume (389,923 m^3 / 1E6 mg/Kg)

## E. DOE/ID-10866, "WASTE ACCEPTANCE CRITERIA FOR ICDF EVAPORATION POND"

DOE/ID-10866, "Waste Acceptance Criteria for ICDF Evaporation Pond" including the main document and appendices should be amended with the following tables.

Table 5-2. Chemical Waste Acceptance Criteria for Evaporation Pond.

Constituent	ICDF Evaporation Pond WAC *	Source of ICDF Evaporation Pond WAC
	(mg/L)	
Carbon Tetrachloride	500	Regulatory Limit
1,1,2-Trichloro-1,2,2-trifluoroethane	100,000	Regulatory Limit
Chloroform	500	Regulatory Limit
PCBs	50	Regulatory Limit
Trichlorofluoromethane	500	Regulatory Limit
Pyridine	500	Regulatory Limit
Bromoform	500	Regulatory Limit
Trans-Acetylene Dichloride (1,2- Dichloroethene)	500	Regulatory Limit
Ether (ethyl ether)	500	Regulatory Limit
m-Cresol (mixed isomers)	100,000	Regulatory Limit and Liner Compatibility
Creosote oil	100,000	Regulatory Limit
Methanol (methyl alcohol)	500	Regulatory Limit
a. ICDF Evaporation Pond WAC - the WAC comes f	rom Table B-1.	

b. From soil conc.(mg/kg) WAC (Table D-1) \* bulk density (1946 Kg/m^3) \* total ICDF soil volume (389,923 m^3 / 1E6 mg/kg)

Attachment 2 April 25, 2005 CCN 55557 Page 6 of 6

Table A-1. Suggested Maximum Leachate Concentrations for Organic Constituents for Liner Compatibility.

Constituent	Predicted Peak Concentration in Leachate *	Compatible Concentration For HDPE be	Compatible Concentration for GCL be	Compatible Concentration for Clay be	Suggested Maximum Leachate Concentration <sup>6</sup>
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Carbon Tetrachloride	29	2,000	•	•	2,000
1,1,2-Trichloro-1,2,2-trifluoroethane	7.98	500,000	•	-	500,000
Chloroform	100	2,000	•	-	2,000
PCBs	0.007	2,000	-	-	2,000
Trichlorofhoromethane	500	2,000	•	-	2,000
Pyridine	267	100,000	-	-	100,000
Bromoform	250	2,000	•	-	2,000
Trans-Acetylene Dichloride (1,2- Dichloroethene)	446	2,000			2,000
Ether (ethyl ether)	941	2,000	•	-	2,000
m-Cresol (mixed isomers)	93.3	100,000	-	-	100,000
Creosote oil	166,667	500,000	-	-	500,000
Methanol (methyl alcohol)	17	500,000	•	•	500,000

- Predicted peak leachate concentration of the ICDF landfill operation (basic methodology described in EDF-ER-274).
- "-" indicates that a specific test value was not available, compatibility issues are not anticipated.
- From manufacturers specifications. (Table 5 in EDF-ER-278 pages 74 78 lists compatible concentration for HDPE liners.)
- The suggested maximum concentration selected for the ICDF liner system is based on the lowest of the concentrations listed for HDPB, GCL, and clay materials and are applicable for the leachate in the landful and the waste liquids in the evaporation ponds.

Table B-1. Maximum Allowable Evaporation Pond Liquid Concentration.

Constituent	Pond Liner Maximum Concentrations	Regulatory Limitations <sup>b</sup>	ICDF Evaporation Pond WAC*	Source of ICDF Evaporation Pond WAC
	(mg/L)	(mg/L)	(mg/L)	
Carbon Tetrachloride	2,000	500	500	Regulatory Limit
1,1,2-Trichloro-1,2,2- trifluoroethane	500,000	100,000	100,000	Regulatory Limit
Chloroform	2,000	500	500	Regulatory Limit
PCBs	2,000	50	50	Regulatory Limit
Trichlorofluoromethane	2,000	500	500	Regulatory Limit
Pyridine	100,000	500	500	Regulatory Limit
Bromoform	2,000	500	500	Regulatory Limit
Trans-Acetylene Dichloride (1,2- Dichloroethene)	2,000	500	500	Regulatory Limit
Ether (ethyl ether)	2,000	500	500	Regulatory Limit
m-Cresol (mixed isomers)	100,000	100,000	100,000	Regulatory Limit and Liner Compatibility
Creosote oil	500,000	100,000	100,000	Regulatory Limit
Methanol (methyl alcohol)	500,000	500	500	Regulatory Limit

a. Prom Table A-1, Column 6.

b. Regulatory Limitations - comes from 40 CFR 264.1050(b) (organics are limited at 10% by weight, 40 CFR 1082(c)(1) (Total VOC concentration cannot exceed 500 mg/L, and the . Toxic Substances Control Act (PCB concentrations in water cannot exceed 50 mg/L).

d. Liquid PCB limit of 50 ppm is from the US Code, Title on Public Health and Welfare, chapter on Solid Waste Disposal. The reference is Title 42, Chapter 82, Subchapter III, 6924(d)(2)(D). "Liquid hazardous wastes containing polychlorinated hiphenyls at concentrations greater than or equal to 50 pprn."

#### APPENDIX D

SAMPLING AND MONITORING PLAN

#### APPENDIX D

# DESIGN ANALYSIS REPORT ASARCO EAST HELENA CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) SAMPLING AND MONITORING PLAN

Prepared for:

ASARCO LLC P.O. Box 1230 East Helena, MT 59635

Prepared by:

Hydrometrics, Inc. 3020 Bozeman Avenue Helena, MT 59601

May 2007

#### TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF FIGURES	iv
LIST OF ATTACHMENT	iv
1.0 INTRODUCTION	1-1
1.1 PROJECT BACKGROUND	1-2
1.2 GENERAL SITE DESCRIPTION	1-3
1.3 GROUNDWATER MONITORING OBJECTIVES	1-3
2.0 HYDROGEOLOGIC SETTING AND GROUNDWATER QUALITY	2-1
3.0 DETECTION MONITORING PROGRAM	3-1
3.1 SAMPLE LOCATIONS AND FREQUENCY	3-1
3.2 SAMPLING METHODOLOGY	3-1
3.3 MONITORING WELL INSPECTION	3-2
3.4 STATIC WATER LEVEL AND TOTAL DEPTH MEASUREMENT	3-2
3.5 WATER QUALITY SAMPLE COLLECTION	3-2
3.6 SAMPLE DOCUMENTATION	3-3
3.7 EQUIPMENT DECONTAMINATION	3-4
3.8 FIELD QUALITY CONTROL SAMPLES	3-5
3.9 SAMPLE HANDLING AND CHAIN-OF-CUSTODY	3-6
3.10 SAMPLE ANALYTICAL PARAMETERS AND METHODS	3-6
4.0 DETECTION MONITORING PROGRAM DATA	
EVALUATION AND REPORTING	4-1
4.1 CONCENTRATION LIMIT COMPARISON	4-1
4.2 STATISTICAL EVALUATION	4-2
4.3 DATA REPORTING	4-5
4.4 GROUNDWATER PROTECTION STANDARD EXCEEDANCES	4-6
4.4.1 Notification Requirement	4-6
4.4.2 Verification Sampling	4-7
4.4.3 Determination Of Source	4-7

4.5 M	ONITORING PROGRAM REVIEW	4-7
5.0 COMPLIANCE MONITORING		
6.0 CORREC	CTIVE ACTION	6-1
7.0 QUALIT	Y ASSURANCE PLAN	7-1
7.1 Pl	ROJECT MANAGEMENT	7-1
	7.1.1 Quality Objectives and Criteria for Measurement Data	7-2
7.2 M	EASUREMENT/DATA ACQUISITION	7-3
	7.2.1 Quality Control Samples and Control Limits	7-3
	7.2.2 Instrument Maintenance and Calibration	7-5
	7.2.3 Data Management and Documentation	7-5
7.3 A	SSESSMENT/OVERSIGHT	7-6
7.4 D	ATA VERIFICATION AND USABILITY	7-7
8.0 REFERE	NCES	8-1
	LIST OF TABLES	
TABLE 2-1.	GROUNDWATER QUALITY OF ASARCO EAST HELENA C	'AMU
	MONITORING WELLS	
TABLE 3-1.	CAMU GROUNDWATER MONITORING WELL COMPLETION	ON
	DETAILS	
TABLE 3-2.	CAMU GROUNDWATER MONITORING SAMPLE CONTAIN	NER AND
	PRESERVATION REQUIREMENTS	
TABLE 3-3.	CAMU GROUNDWATER ANALYTICAL PARAMETER LIST	Γ
TABLE 3-4.	CONCENTRATION LIMITS FOR CONSTITUENTS OF CONC	CERN
TABLE 7-1.	DATA VALIDATION CODES AND DEFINITIONS	

#### LIST OF FIGURES

FIGURE 1-1. GENERAL LOCATION MAP

FIGURE 1-2. ASARCO EAST HELENA CAMU AREA MONITORING WELLS AND NOVEMBER 2006 WATER LEVELS

#### LIST OF ATTACHMENTS

ATTACHMENT A MONITORING WELL LOGS

ATTACHMENT B MONITORING WELL INSPECTION FORM

ATTACHMENT C DATA SUMMARY FOR DETERMINATION OF

**CONCENTRATION LIMITS** 

#### APPENDIX D

## DESIGN ANALYSIS REPORT ASARCO EAST HELENA CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) SAMPLING AND MONITORING PLAN

#### 1.0 INTRODUCTION

This Sampling and Monitoring Plan (SMP) for the Asarco East Helena Corrective Action Management Unit (CAMU) is intended to provide guidance on the collection, analysis, and reporting of groundwater data for the suite of monitoring wells installed for the specific purpose of evaluating potential impacts from the CAMU Phase 1 and Phase 2 Cells. The SMP has been prepared as Appendix D to the Design Analysis Report for the CAMU Phase 2 Cell (Hydrometrics, 2007a). In accordance with the CAMU regulations at 40 CFR §264.551 and §264.552, the SMP provides "requirements for sampling and monitoring and corrective action that are sufficient to (i) continue to detect and to characterize the nature, extent, concentration, direction, and movement of existing releases of hazardous constituents in ground water from sources located within the CAMU; (ii) detect and subsequently characterize releases of hazardous constituents to ground water that may occur from areas of the CAMU in which wastes will remain in place after closure of the CAMU; and (iii) require notification to the Regional Administrator and corrective action as necessary to protect human health and the environment for releases to ground water from the CAMU." The groundwater monitoring procedures set forth in this plan also address the 40 CFR §264 Subpart F requirements for detecting, characterizing, and responding to releases from solid waste management units to the uppermost aquifer beneath the unit.

At the same time, the procedures and methodologies outlined in this SMP have been developed to be generally consistent with the recently revised (April 2007) post-RI groundwater monitoring encompassing the Asarco East Helena site and the community of H:\Files\007 ASARCO\6043\R07 CAMU SMP Revised 4-2007.Doc\HLN\5/3/07\065

East Helena. A significant dataset has been established for the CAMU monitoring wells over the last six years, under the post-RI semiannual monitoring program. Therefore, to maintain data comparability, the CAMU SMP is based on revised post-RI program.

#### 1.1 PROJECT BACKGROUND

Environmental investigations and remedial activities at the Asarco LLC (Asarco) East Helena Smelter site in East Helena, Montana, are currently proceeding under a Consent Decree with the United States Environmental Protection Agency (EPA). In January 1998, the EPA and Asarco entered into a Consent Decree (CV 98-3-H-CCL) under the Resource Conservation and Recovery Act (RCRA) that required Asarco to investigate and correct releases of arsenic and metals in groundwater and soils at the East Helena Smelter.

The CAMU Phase 1 Cell, a Subtitle C landfill located southwest of the East Helena Smelter, was constructed in 2001 to accept soils, sediments and demolition debris resulting primarily from remedial cleanup activities at the plant. The cell is constructed as follows (from bottom to top:

- 1. A well-compacted subgrade is covered by a three-foot compacted clay liner;
- 2. Above the clay liner are a 60-mil HDPE liner and 250-mil geonet drainage layer (the leak detection layer), and an additional 60-mil HDPE liner and 250-mil geonet drainage layer (the leachate collection layer);
- 3. The leachate collection layer is overlain by a geotextile layer;
- 4. Above the geotextile layer is a layer of waste material up to 20 feet thick;
- 5. A composite cap of geosynthetic clay and a 40-mil HDPE liner covers the waste material; and
- 6. A drainage layer (one foot of clean sand) above the cap is covered by two feet of cover soil and six inches of topsoil, vegetated with a grass cover.

The leachate collection and leak detection layers drain to 4-inch perforated HDPE pipes and subsequently to collection sumps, which are accessible from the surface via 4-inch HDPE pipes with removable screw caps to allow removal of any leachate by pumping.

Under a Consent Decree with the State of Montana, process unit cleaning and building demolition is occurring at the East Helena plant (the conditions of the Montana Consent Decree officially expired on December 31, 2006). A key component of facility process unit material removal and site demolition is the construction of a CAMU Phase 2 Cell for containment of demolition debris. Engineering design and analysis was recently completed for the CAMU Phase 2 Cell (Hydrometrics, 2007a), which will contain plant site soil and demolition debris generated through the implementation of the Montana Consent Decree and the RCRA Consent Decree.

#### 1.2 GENERAL SITE DESCRIPTION

The East Helena plant is a custom lead smelter situated on an approximately 142-acre site. The plant is described in detail in other documents, particularly the Comprehensive Remedial Investigation/Feasibility Study (RI/FS, Hydrometrics, 1990), the Current Conditions Release Assessment (CCRA, Hydrometrics, 1999), and the RCRA Facility Investigation (RFI, ACI, 2003). The plant is bounded to the south by Upper Lake and Lower Lake, to the east and northeast by Prickly Pear Creek, and to the north by the City of East Helena and American Chemet. The existing CAMU Phase 1 Cell and the proposed CAMU Phase 2 Cell are located in open fields south-southwest of the plant site near Upper Lake (Figure 1-1).

#### 1.3 GROUNDWATER MONITORING OBJECTIVES

Ten groundwater monitoring wells (designated MW-1 through MW-10) have been installed in the immediate vicinity of the existing and proposed CAMU cells to assess potential releases of constituents of concern (arsenic and other metals) to groundwater. An additional monitoring well (MW-11) was installed in May 2007 to aid in defining groundwater flow directions. Monitoring well locations are shown on Figure 1-2, along with the most recent groundwater elevation data collected in November 2006. As noted in the Technical Inspection Report for the CAMU Phase 1 Cell (Hydrometrics, 2007b), a CAMU-specific groundwater monitoring program has not previously been implemented for the Asarco East Helena site. Instead, from 2001 through 2006 the CAMU monitoring well network was

incorporated into the post-RI sampling program, sampled and analyzed on a semiannual basis for the same parameters as other site monitoring wells.

The SMP for the Asarco East Helena CAMU is structured as follows:

- Section 2.0 provides an overview of site hydrogeology and groundwater quality;
- Section 3.0 discusses monitoring locations and frequency;
- Section 4.0 presents sampling methodology for the CAMU monitoring wells;
- Section 5.0 discusses sample handling and analysis procedures;
- Section 6.0 presents statistical evaluation and reporting requirements;
- Section 7.0 provides a Quality Assurance Plan for the CAMU groundwater monitoring; and
- Document references are contained in Section 8.0.

1-4

#### 2.0 HYDROGEOLOGIC SETTING AND GROUNDWATER QUALITY

The Asarco plant and the East Helena community are underlain by unconsolidated alluvium deposited by ancestral Prickly Pear Creek. The alluvial deposits are highly variable in composition containing mixtures of cobbles, gravel, sand, silt and clay within this unit. Underlying the alluvium, and present in exposures west and north of the plant and the East Helena community, are fine-grained Tertiary volcanic ash tuff deposits. These tuff deposits have low permeabilities and have weathered to fine clay in some locations.

Groundwater is present in the unconsolidated Quaternary deposits throughout most of the site with the exception of the western edge of the plant site where the Tertiary ash deposits form a shallow ridge. A perched groundwater system is also found in surficial slag/fill deposits on portions of the Asarco plant site where the slag and fill are underlain by relatively low permeability marsh deposits. Depth to groundwater in the vicinity of the Asarco plant site ranges from 10 feet to 60 feet, becoming deeper to the north and in areas away from Prickly Pear Creek. The general groundwater flow direction is to the north and northwest. Asarco plant site groundwater receives recharge from Upper Lake and Lower Lake in the Asarco plant area, and from Prickly Pear Creek in the area immediately downstream.

Monitoring well logs for the ten CAMU monitoring wells (designated MW-1 through MW-10) are in Attachment A. Groundwater flow patterns in the immediate vicinity of the CAMU are complex and difficult to interpret consistently from groundwater elevation data, presumably due to impacts on the local water table from Upper Lake and the effect of layered or perched groundwater zones within the volcanic ash unit, overlying a more extensive regional Tertiary alluvial aquifer. Groundwater elevations and flow directions were evaluated at some length in the Technical Inspection Report (Hydrometrics, 2007b). This discussion is summarized below.

Wells MW-6, MW-2, and MW-3 have consistently shown the highest water levels in the CAMU monitoring well network, based on data collected from 2000 through 2006. Well

MW-6 is also the only CAMU monitoring well completed in the unconsolidated alluvial deposits rather than the volcanic ash unit. The water levels in CAMU wells and site well DH-2 (Figure 1-2) suggest a northward groundwater flow direction along the northern portion of the CAMU area, which is generally consistent with regional groundwater flow. Prior to 2006 (and the installation of wells MW-8, MW-9, and MW-10) there also appeared to be a localized southerly flow direction along the southern boundary of the CAMU Phase 1 Cell.

Groundwater data collected in 2006 show lower potentiometric surface elevations in the CAMU Phase 2 Cell area (Figure 1-2). This apparent low may be misleading since water levels in the ash unit are layered or perched, and may not be representative of groundwater flow in a single site-wide groundwater system. In many cases, wells that were drilled the deepest have lower groundwater elevations, suggesting that the ash unit behaves as a layered perched unit with variable water elevations that are dependent on well depths and screened intervals.

Groundwater quality in the CAMU monitoring wells has been measured as part of the post-RI/FS monitoring program since November 2000. Table 2-1 is a statistical summary of observed water quality at wells MW-1 through MW-7 from Fall 2000 through Spring 2006. Wells MW-8, MW-9, and MW-10 were installed in 2006 and sampled during the most recent (November 2006) monitoring event.

As shown in Table 2-1, overall water quality in the CAMU monitoring wells is good, with low to moderate concentrations of major ions, near-neutral pH values (averaging 6.90 to 7.46), and dissolved metals concentrations that are generally below or near laboratory reporting limits. Cadmium, copper, lead, and zinc are nearly always below laboratory detection limits. Cadmium has been reported one time at a concentration of 0.002 mg/L in well MW-4, copper has been reported one time in well MW-6 at a concentration of 0.004 mg/L, lead has been reported twice, at 0.007 mg/L (MW-1) and 0.009 mg/L (MW-6), and zinc has never been above the laboratory detection limit of 0.01 or 0.02 mg/L. Dissolved arsenic concentrations show considerable variability among wells, with average concentrations ranging from 0.004 mg/L at well MW-4 to 0.159 mg/L at well MW-6. H:\Files\007 ASARCO\6043\R07 CAMU SMP Revised 4-2007.Doc\HLN\5/3/07\065

Similarly, average manganese concentrations range from 0.019 mg/L at wells MW-4 and MW-5 to 4.99 mg/L at MW-6, and average iron concentrations range from 0.025 mg/L at MW-5 to 0.219 mg/L at MW-6. Major ions also show substantial variability among wells, with the following average concentration ranges observed for the CAMU well dataset: calcium (18.7 to 93.6 mg/L), magnesium (5.5 to 20.3 mg/L), sulfate (21.8 to 72.3 mg/L), and bicarbonate (109 to 351 mg/L). Well MW-6 typically shows higher concentrations than other CAMU wells for most chemical constituents tested. As shown on Figure 1-2, this well also has a higher groundwater elevation than other CAMU wells, and may be influenced by flow from the east. In fact, concentrations of arsenic and manganese at MW-6 are similar to those observed at well DH-20, located about 450 feet east-northeast of MW-6.

#### 3.0 DETECTION MONITORING PROGRAM

This Section of the SMP outlines a detection monitoring program for the CAMU Phase 1 and Phase 2 Cells, as outlined in 40 CFR §264 Subpart F.

#### 3.1 SAMPLE LOCATIONS AND FREQUENCY

Groundwater monitoring at the CAMU wells will be conducted at eleven monitoring locations (Figure 1-2) on a quarterly basis. These eleven monitoring wells will serve as compliance points (40 CFR §264.95). Sampling will be conducted once per calendar quarter, in order to provide groundwater elevation and quality data for contrasting points on the seasonal groundwater hydrograph.

Four monitoring wells are located around the perimeter of each of the two CAMU cells, covering each potential flow direction. The CAMU Phase 1 Cell is bordered by monitoring wells MW-1, MW-2, MW-3, and MW-4. The CAMU Phase 2 Cell is bordered by monitoring wells MW-5, MW-8, MW-9, and MW-10. Two additional monitoring wells, MW-6 and MW-7, are located in the area of the CAMU cells. Monitoring well MW-11 was installed west of the CAMU Phase 2 Cell location in 2007. Wells MW-1 through MW-11 were or will be installed for the specific purpose of monitoring water quality in the vicinity of both CAMU cells. Groundwater monitoring locations are described in Table 3-1 and shown on Figure 1-2. Monitoring well logs are in Attachment A.

#### 3.2 SAMPLING METHODOLOGY

Collection of groundwater samples from the CAMU monitoring wells will generally consist of four steps:

- 1. Inspection of the monitoring well to verify well integrity;
- 2. Measurement of static water level;
- 3. Well purging and monitoring for field parameter stabilization; and
- 4. Water quality sample collection.

#### 3.3 MONITORING WELL INSPECTION

As part of the detection monitoring program, during each quarterly monitoring event, all CAMU monitoring wells will be inspected to verify the integrity of the installation. A well inspection form (Attachment B) will be completed for each monitoring well site.

#### 3.4 STATIC WATER LEVEL AND TOTAL DEPTH MEASUREMENT

Prior to collection of samples, the static water level will be measured at each well using an electric water level probe to determine the depth to groundwater below a specified measuring point (typically the top of the PVC well casing). Water level measurements will be combined with surveyed measuring point elevations (Table 3-1) to compute groundwater elevations at each monitoring point.

The total depth of each CAMU monitoring well will be measured at least annually, as part of the well inspection procedure. Decreases in total depth can occur due to collapsing or breached well casings, or improperly designed or installed well screens.

#### 3.5 WATER QUALITY SAMPLE COLLECTION

Dedicated tubing installed in each monitoring well and a 12-volt submersible pump will be used to purge and sample monitoring wells. Purging will consist of removing three to five well volumes while routinely monitoring field parameters (pH, dissolved oxygen, temperature, specific conductance) at least twice during removal of each well volume. Field parameters will be measured using a flow-through device to minimize potential effects from atmospheric exposure. Purge water will be containerized and dispensed into the Asarco plant water treatment system.

Samples for laboratory analysis will be collected only after one of the following purge conditions is met:

 A minimum of three well volumes have been removed and successive field parameter measurements agree to within the stability criteria given below;

- At least five well volumes have been removed although field parameter stabilization criteria are not yet met; or
- The well has been pumped dry and allowed to recover sufficiently such that adequate sample volumes for rinsing equipment and collecting samples can be removed.

Criteria for field parameter stabilization are as follows:

Parameter (Units)	Stability Criteria	
pH (standard units)	± 0.1 s.u.	
water temperature (°C)	± 0.2 °C	
specific conductance (µmhos/cm)	± 5% (SC ≤ 100 μmhos/cm) ± 3% (SC > 100 μmhos/cm)	
dissolved oxygen (mg/L)	± 0.3 mg/L	

NOTE: Stability criteria obtained from USGS National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples (September 1999).

Following well purging, final field parameter measurements will be collected and recorded, and groundwater quality samples will be obtained. Sample bottles will be filled directly from a sampling port, prior to the pumped water passing through the flow-through cell.

Sample containers will be rinsed three times with sample water prior to sample collection, then preserved as appropriate for the intended analysis (e.g. nitric acid preservation to pH <2 for metals analysis), and stored on ice in coolers at approximately 4°C for transport. Filtered samples (for dissolved metals analyses) will be processed through a single-use 0.45  $\mu$ m poresize disposable filter prior to preservation.

#### 3.6 SAMPLE DOCUMENTATION

All groundwater quality sampling information will be documented in waterproof ink in a dedicated project field notebook. Notebook entries will include, at a minimum, the following information:

- Project name;
- Date and time;
- Sample location;

- Sample number;
- Media type;
- Field meter calibration information;
- Sampling personnel present;
- Analyses requested;
- Sample preservation;
- Field observations (field parameter measurements, appearance of sample);
- Weather observations; and
- Other relevant project-specific site or sample information.

Entries will be made in permanent ink, with corrections crossed out with a single line, dated and initialed. Field books will be signed and dated at the bottom of each page by personnel making entries on that page.

Individual samples (including QC samples) will be assigned unique sample numbers according to the following sample numbering scheme:

#### AAA-YYMM-XXX

where AAA is a three-character code denoting the project, YYMM is a four-digit code denoting the year (i.e., 07 for 2007) and month (i.e., 05 for May) of collection, and XXX is a three-digit code that is incremented sequentially for each successive sample (i.e., if the first sample collected is 100, then subsequent samples are numbered 101, 102, 103, etc.).

Additional information to be included on the sample container label will include the date and time of collection, sample preservation information, and requested analytical parameters for the sample.

#### 3.7 EQUIPMENT DECONTAMINATION

Groundwater sampling equipment reused between monitoring locations (sampling pump and short piece of discharge line used to connect to the dedicated well tubing) will be thoroughly

3-4

decontaminated between uses. Equipment decontamination will consist of the following steps:

- Rinse with about 3 gallons of soapy water (Alconox or other non-phosphate detergent);
- Rinse with about 5 gallons of clean tap water; and
- Final rinse with about 3 gallons of distilled or deionized water.

The effectiveness of the decontamination procedure will be evaluated through the periodic collection of equipment rinsate and deionized water blanks, as described below.

#### 3.8 FIELD QUALITY CONTROL SAMPLES

Field quality control (QC) samples will be collected and analyzed as part of the CAMU groundwater monitoring program for evaluation of data quality. The collection of field QC samples is also part of the site-wide post-RI monitoring program. The QC samples specified for collection as part of the CAMU monitoring program will also serve as QC samples for the post-RI monitoring program.

Required groundwater field QC sample types and QC sample frequency for the CAMU groundwater monitoring program will be as follows:

- Equipment rinsate blanks one per CAMU monitoring event;
- Deionized water blanks one per CAMU monitoring event; and
- Field duplicate samples one per CAMU monitoring event.

Blank samples are collected to estimate the potential for sample contamination from any materials contacting sample water (filtration equipment, bottles, preservatives etc.) and from random atmospheric contamination. The deionized water blank sample will be collected by filling sample bottles with reagent-free deionized water in the field, preserving as appropriate, and submitting the sample blind to the laboratory for analysis. The equipment rinsate blank will consist of deionized water processed through decontaminated sample

collection equipment (including pump, discharge lines and filtration equipment as appropriate).

Field duplicate samples will be collected to estimate field and laboratory precision (reproducibility). Field duplicate samples will be collected by sequentially filling two sets of sample bottles at the same monitoring location, assigning unique sample numbers to the two samples, and submitting both samples to the laboratory for analysis.

All field QC samples will be submitted blind to the laboratory (QC samples will be packaged and shipped in such a manner that the laboratory will not be aware of the nature of the samples). Further discussion of QC samples, including required laboratory QC samples and target control limits for both field and laboratory QC samples, is presented in Section 7.0.

#### 3.9 SAMPLE HANDLING AND CHAIN-OF-CUSTODY

Sample containers and preservation methods for CAMU groundwater samples are listed in Table 3-2. Samples will be transferred to the laboratory (hand-delivered) either the day of sample collection or the next day. During field storage, samples will be maintained in coolers, iced to a temperature of approximately 4° C.

Chain-of-custody procedures will be followed throughout the project by utilizing standard chain-of-custody forms to transfer samples from the field to the laboratory. Each cooler of delivered samples will be accompanied by a cover letter, analytical parameter list, and chain-of-custody documentation for recording the transfer of samples from the possession of field personnel to the possession of the laboratory.

#### 3.10 SAMPLE ANALYTICAL PARAMETERS AND METHODS

The primary analytical laboratory for the analysis of water samples collected under this SMP will be Energy Laboratories in Helena, Montana. Groundwater samples will be tested for the parameters listed in Table 3-3, using the appropriate method to achieve the specified quantitation levels. Field-measured parameters include pH, specific conductance, water

temperature, and dissolved oxygen. Laboratory parameters include major ions (calcium, magnesium, sodium, potassium, sulfate, and chloride), total dissolved solids, alkalinity, specific conductance, and an extended suite of dissolved metals (see Table 3-3), including speciation of both arsenic (arsenic (III) and arsenic (V) forms) and selenium (selenium (IV) and selenium (VI) forms). The extended suite of metals includes constituents listed in both Appendix VII of 40 CFR §261 (Hazardous Constituents) and 40 CFR §264 Appendix IX (Ground-Water Monitoring List). Metals (including arsenic and selenium) are considered the constituents of concern for the CAMU wells, based on the history of the Asarco Plant site and the nature of the materials in the CAMU Phase 1 Cell and the materials scheduled for placement in the CAMU Phase 2 Cell.

## 4.0 DETECTION MONITORING PROGRAM DATA EVALUATION AND REPORTING

This section of the SMP details the data evaluation and reporting requirements for the detection monitoring program, the monitoring components of which are presented above in Section 3.0. The data evaluation will determine whether, based on the most recent groundwater sampling results, an exceedance of the groundwater protection standard for the CAMU has occurred. For the purposes of this Sampling and Monitoring Plan, an exceedance of a groundwater protection standard at a compliance point will be indicated by either of the following:

- 1. A concentration for a constituent of concern (metals, including arsenic and selenium) from any of the eleven CAMU monitoring wells is greater than a specified concentration limit for that parameter at that well (see Section 4.1); or
- 2. A statistical evaluation of the data indicates that there is statistically significant evidence of contamination at a compliance point (see Section 4.2).

Currently, the data set for the CAMU wells for constituents of concern includes arsenic, cadmium, copper, iron, lead, manganese, and zinc, for wells MW-1 through MW-7. Therefore, evaluation of data under the detection monitoring program will be limited to these seven wells and seven parameters in 2007. As noted in Section 3.10, an extended suite of metals analytes and a quarterly monitoring frequency is proposed for all CAMU wells (MW-1 through MW-11) beginning with the 2007 groundwater sampling events. Following the first full year of quarterly data collection and establishment of a sufficient database, concentration limit calculations and comparisons, and statistical evaluations will be conducted for the newer CAMU wells, and for additional constituents of concern (other metals) based on the initial year of quarterly results.

#### 4.1 CONCENTRATION LIMIT COMPARISON

Requirements for establishing concentration limits for hazardous constituents in groundwater at solid waste management units are presented in 40 CFR §264.94. As noted in Section 2.0 H:\Files\007 ASARCO\6043\R07 CAMU SMP Revised 4-2007.Doc\HLN\5/3/07\065

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above, the groundwater chemistry in CAMU monitoring wells is quite variable, and the complexity of the hydrogeologic system makes defining upgradient (background) and downgradient wells difficult. Therefore, in order to determine concentration limits for the CAMU monitoring wells, the following procedure was employed to estimate background levels of constituents of concern for each well:

- 1. Available metals data was compiled for each well, with averages and standard deviations calculated, along with the total number of samples and the number of samples with data below the reporting limit (Attachment C);
- 2. Concentration limits were assigned based on one of the following criteria:
  - a. If all data were below reporting limits, the practical quantitation limit (PQL) for the parameter (Table 3-3) was established as the concentration limit;
  - b. If more than 50% of the data were below reporting limits, 3 x PQL was established as the concentration limit;
  - c. If less than 50% of the data were below the reporting limit, the concentration limit was established as the average plus two standard deviations.

The well-specific concentration limits for each parameter for the CAMU wells are shown in Table 3-4. The method described above for determining concentration limits is intended to account for some expected natural variability in reported concentrations (due to fluctuations in true concentrations and to inherent sampling and analytical variability), as well as the observed interwell variability, while remaining sufficiently low to allow detection of potential groundwater impacts from the CAMU Phase 1 and/or Phase 2 Cells.

#### 4.2 STATISTICAL EVALUATION

The purpose of the statistical evaluation of CAMU groundwater monitoring data is to "detect and characterize" potential groundwater quality impacts from materials within the CAMU (see Section 1.2), to allow for appropriate responses to protect human health and the environment. EPA guidance on the statistical evaluation of groundwater monitoring data at RCRA facilities (EPA, 1989 and 1992) discusses various data assessment techniques that may be used depending on the particular characteristics of the dataset for individual wells and H:\Files\007\_ASARCO\6043\R07 CAMU SMP Revised 4-2007.Doc\HLN\5/3/07\065

as a whole. At the same time, the EPA documents recognize that the suggested methods are guidance rather than regulation, and that a flexible, site-specific approach to acceptable statistical methods of evaluation is necessary. This section presents the statistical evaluation proposed for the CAMU monitoring well network, based on a consideration of groundwater flow patterns and groundwater quality observed to date, applicable RCRA and other statistical guidance, and on the requirements of 40 CFR §264.97(h).

Statistical guidance for RCRA facilities (EPA, 1989 and 1992) is primarily based on comparisons of parameter concentrations in background wells with concentrations in downgradient wells. Various methods (prediction or tolerance intervals, analysis of variance (ANOVA), control charts) are suggested to test for statistically significant differences in background versus compliance well concentrations, which may indicate groundwater impacts if compliance well concentrations are higher than background concentrations in a statistically significant sense. These tests are "inter-well" methods, comparing datasets from different monitoring locations.

Inter-well procedures are not considered appropriate for the Asarco CAMU groundwater monitoring program, for the following reasons:

- As noted in Section 2.0, measured groundwater elevations in the CAMU area are not readily interpreted to yield a consistent groundwater flow direction, with well-defined upgradient and downgradient wells;
- The data collected prior to placement of materials in the CAMU Phase 1 Cell is limited to two sampling events (November 2000 and May 2001), and does not include all of the current monitoring well sites. Thus, the background dataset for individual wells is less than ideal for determining representative background concentrations; and
- Groundwater quality data collected to date show considerable inter-well variability (see Section 2.0 and Table 2-1) both before and after placement of materials in the CAMU Phase 1 Cell.

Therefore, an intrawell approach to statistical evaluation is proposed for the Asarco CAMU groundwater monitoring program, where data from each individual well is compared with previous data collected at that well, to assess changes over time. In essence, this method considers all of the CAMU monitoring wells as "downgradient" wells potentially affected by any impact from the CAMU.

The intrawell statistical test that will be used by Asarco to evaluate CAMU groundwater monitoring data is the Mann-Kendall test for trend, described by Helsel and Hirsch (2002) and Helsel et al. (2005). The Mann-Kendall trend test is a nonparametric test that evaluates whether a particular variable at a particular well shows a tendency to increase over time. The Mann-Kendall test may be conducted using software available from the USGS (Helsel et al., 2005), or by any number of commercially available statistics programs. The significance level (Type I error level) for the Mann-Kendall test will be set at  $\alpha = 0.01$ , such that the probability of the test resulting in a false positive (incorrectly identifying an increasing trend when none is present) is 1% or less. Groundwater data will be tested using both the general Mann-Kendall test and the Seasonal Mann-Kendall test. The Seasonal Mann-Kendall test accounts for any seasonal effects in the dataset, such as variable groundwater elevations, and removes these effects from the computation of the test result, so that seasonality in the dataset has a minimal influence on the statistical significance of the trend test (Helsel and Hirsch, 2002).

Mann-Kendall trend testing will be conducted on metals data (including arsenic and selenium) for each of the eleven CAMU monitoring wells. If continued data collection shows that certain parameters are routinely at or below reporting limits, statistical testing may be discontinued in consultation with the agencies. As noted in EPA (1992), "By limiting the number of tested constituents to the most useful indicators, the overall number of statistical comparisons that must be made can be reduced, lowering the facility-wide false-alarm rate."

Another intrawell comparison procedure for groundwater data is the control chart (EPA, 1992). Control charts have the benefit of allowing data to be viewed graphically over time.

A reasonable number of background data points are required in order to establish reliable estimates of mean concentrations and parameter variability (a minimum of eight points are recommended). If the Mann-Kendall trend test conducted on the CAMU groundwater data indicates that there is no long-term trend in the data over a considerable period of time (8-10 years), a control chart approach for monitoring the CAMU wells could be implemented to complement the Mann-Kendall trend test statistics. The Shewhart-cumulative sum (CUSUM) Control Chart described in EPA (1992), using the initial 8-10 groundwater data points as a baseline for each well, would be an appropriate method for the CAMU wells. While this procedure is not proposed as a routine statistical test at this time, Asarco and the agencies may wish to consider including analysis of the groundwater data using a control chart as the data set expands.

The statistical tests proposed for the evaluation of CAMU monitoring well data have been selected based on the properties of the existing data set and the hydrogeologic conditions observed at the site. As additional data (new wells and an expanded set of parameters) are collected under the detection monitoring program outlined in Section 3.0, alternative methods of statistical analysis may be recognized as appropriate techniques for detecting potential releases to groundwater from the CAMU. Therefore, statistical procedures other than those suggested above may be used to evaluate site data. Any statistical method used to evaluate CAMU groundwater data will comply with 40 CFR §264.97(h) and (i).

#### 4.3 DATA REPORTING

Following quarterly groundwater monitoring events, a Data Submittal will be prepared for EPA within thirty days of the receipt of analytical results from the laboratory. The semiannual Data Submittal will include the following:

- Copies of field notes and laboratory analytical results for the most recent monitoring events;
- Tabulated unique sample numbers (Section 3.6) and corresponding sample locations;

- Results of the statistical testing for each well for each of the parameters described above, including a summary of any statistically significant trends or exceedances identified;
- Concentration contour maps for any detected constituents of concern (arsenic and metals);
- Updated time-concentration plots for each well for all analyzed parameters; and
- A tabulated summary of the groundwater data for the most recent monitoring events.

The quarterly Data Submittals may be provided in hard copy, digital electronic format, or both at the discretion of the agency.

In addition to the quarterly Data Submittals, an Annual Groundwater Monitoring Report (GMR) will be prepared for EPA and submitted no later than March 31<sup>st</sup> of each year. The GMR will contain, at a minimum, the following information:

- Updated groundwater elevation and potentiometric contour maps for each of the previous year's monitoring events, along with updated hydrographs for each of the wells (temporal plots of changes in water elevation over time);
- A summary of results of the statistical testing completed during the previous year; and
- A discussion of statistical results, observed trends, data quality (see Section 7.0), deviations from the SMP, and any other issues pertinent to the CAMU groundwater monitoring program.

#### 4.4 GROUNDWATER PROTECTION STANDARD EXCEEDANCES

#### 4.4.1 Notification Requirement

If an exceedance of the groundwater protection standard is observed for any CAMU monitoring well (either an exceedance of a concentration limit, or a finding of statistical evidence of contamination), Asarco will notify EPA within seven days of the finding, specifying the nature and location of the exceedance (40 CFR §264.98(g)(1)).

## 4.4.2 Verification Sampling

For any well where one or more parameters is found to exceed a groundwater protection standard, the well will be resampled within 30 days of notification to EPA, unless Asarco and EPA in consultation determine that resampling is not necessary, or that resampling may occur on an alternate schedule. This verification sampling will only be required for those parameters and at those wells where groundwater protection standard exceedances were indicated during the most recent monitoring event.

If the verification sample also indicates an exceedance of the groundwater protection standard, a compliance monitoring program will be initiated (Section 5.0), and Asarco will determine whether or not the exceedances are attributable to the CAMU cells (Section 4.4.3).

#### 4.4.3 Determination Of Source

If a verification sample indicates an exceedance of a groundwater protection standard, Asarco may make a demonstration that the groundwater protection standard was exceeded due to sources other than the CAMU, or to errors in sampling, analysis, or evaluation. Asarco shall notify EPA within seven days of receiving the verification sample results if this demonstration will be made. The report demonstrating that non-compliance with the groundwater protection standard is attributable to a factor other than a release from the CAMU will be submitted to EPA within 90 days of the notification. Compliance monitoring (Section 5.0) will continue during this period, until EPA provides written notice to Asarco that the detection monitoring program may resume.

### 4.5 MONITORING PROGRAM REVIEW

Following the receipt of semiannual monitoring data and preparation of Data Submittals and/or the Annual GMR, Asarco, EPA, and MDEQ should re-evaluate the CAMU groundwater monitoring program to determine if changes are warranted (e.g. modifications to the analytical parameter list, changes in sampling frequency, installation of additional wells) based on the most recent analytical and statistical results. Any changes to the detection monitoring program for the CAMU will be subject to Asarco and agency approval.

### 5.0 COMPLIANCE MONITORING

A compliance monitoring program will be implemented for the Asarco CAMU groundwater monitoring wells, if the sampling and data evaluation under the detection monitoring program determines that a groundwater protection standard has been exceeded, and that the exceedance is attributable to a release to groundwater from the CAMU (Section 4.4). If a compliance monitoring program is required, Asarco will submit a plan for compliance monitoring to EPA within 90 days of determining this requirement. The compliance monitoring program may be based on the detection monitoring program, but will also include any additional information necessary to comply with 40 CFR §264.99, such as the following:

- Any proposed changes to the groundwater monitoring network;
- Any proposed changes to monitoring frequency, parameters, or analytical methods;
   and
- Any proposed changes to groundwater protection standards (concentration limits and/or statistical evaluation methods).

If the statistical evaluation of groundwater data collected under the compliance monitoring program indicates exceedance of a groundwater protection standard, Asarco will notify EPA of this finding within seven days. Verification sampling and determination of sources under the compliance monitoring program may proceed as described in Sections 4.42 and 4.4.3 above for the detection monitoring program. If compliance monitoring data indicate exceedance of a groundwater protection standard, and that the exceedance is due to a release from the CAMU, Asarco will be required to establish a corrective action program (Section 6.0). As noted previously, compliance monitoring will continue until written notification from EPA that detection monitoring may resume.

5-1

### 6.0 CORRECTIVE ACTION

If a corrective action program is required based on an exceedance of a groundwater protection standard observed during implementation of a compliance monitoring program, Asarco will propose a corrective action to ensure that prevents hazardous constituents from exceeding applicable limits at the compliance point(s) by removing the hazardous constituents or treating them in place. Within 180 days of determining a corrective action program is necessary, Asarco will submit a plan detailing the corrective action program that complies with 40 CFR §264.100, and includes the following:

- A description of the specific measures to be taken to prevent hazardous constituents from exceeding applicable limits at the compliance point(s);
- A groundwater monitoring program to demonstrate the effectiveness of the corrective action program; and
- Provisions for annual reporting to EPA of the effectiveness of the corrective action program.

Asarco will continue corrective action measures for as long as necessary to achieve compliance with the groundwater protection standard. Corrective measures may be terminated based on a period of demonstrated compliance with the groundwater protection standard, to be determined on a case-specific basis by EPA.

6-1

## 7.0 QUALITY ASSURANCE PLAN

This section of the Asarco CAMU SMP provides guidance on quality assurance requirements for monitoring plan implementation. The Quality Assurance Plan (QAP) has been prepared in general accordance with applicable U.S. Environmental Protection Agency (EPA) guidance (EPA 1998a, 1998b). In general, the QAP outlines field and laboratory methodologies that will be required for completion of specific project activities, with the goal of generating a data set of sufficient quality to support future regulatory and/or remedial decisions concerning the CAMU. The content and level of detail in the QAP have been structured to be appropriate to the scope of work outlined above. The QAP is organized as follows, corresponding to the four standardized groups of required elements for quality assurance plans (EPA, 1998b):

- Section 7.1 -- Project Management;
- Section 7.2 -- Measurement/Data Acquisition;
- Section 7.3 -- Assessment/Oversight; and
- Section 7.4 -- Data Validation and Usability.

#### 7.1 PROJECT MANAGEMENT

Overall project management for groundwater monitoring at the Asarco East Helena CAMU will be coordinated by Asarco and EPA. Designated project managers from Asarco and EPA will be the primary data users and decision-makers for the Asarco CAMU.

Asarco or a contractor selected by Asarco will implement the CAMU SMP, and will be responsible for providing staff to fill the following positions:

- Project Management;
- Health and Safety Officer;
- QA/QC Officer;

- Field Team Leader; and
- Field crews and/or subcontractors for environmental sampling and any additional field activities.

As noted previously, Asarco has entered into a Consent Decree with EPA (Section 1.0). This SMP represents a plan for ongoing evaluation of potential impacts to groundwater from the existing CAMU Phase 1 and proposed CAMU Phase 2 Cells at the Asarco East Helena site. The scope of work for the groundwater monitoring project is described in detail in Sections 2.0 through 6.0 of this document.

### 7.1.1 Quality Objectives and Criteria for Measurement Data

Quality objectives and criteria for measurement data have been developed for the Asarco CAMU groundwater monitoring program in general accordance with the Data Quality Objectives (DQO) process (EPA, 1994). The purpose of the DQO process is to ensure that data of the appropriate type, quality, and quantity are collected to support decisions to be made at the site.

The overall objective of the CAMU SMP is to detect and characterize any releases to groundwater from the CAMU through a program of data collection and statistical analysis. The decision to be made with respect to the CAMU groundwater monitoring data can be stated as follows: "Does the cumulative CAMU groundwater data indicate that impacts to groundwater from the CAMU are occurring?" The statistical procedures outlined in Section 6.0 describe the methods that will be used to address this question. In addition, the following analytical data quality objectives and measurement criteria have been incorporated into the Asarco CAMU SMP:

 The sampling design, field methods, and analytical requirements have been specifically identified to ensure that representative samples are collected and analyzed;

- 2. Field and laboratory quality control samples and target control limits are stipulated in Section 7.2, to provide estimates of data precision, accuracy, and completeness; and
- 3. Provisions for required field and analytical documentation, project oversight, and data review procedures are also presented in Sections 3.0 through 6.0 above, and in Sections 7.3 and 7.4.

Adherence to the procedures and requirements set forth in this SMP will generate a defensible data set, minimizing the likelihood of potential decision errors at the Asarco CAMU for both false positive errors (i.e., deciding that a release from the CAMU is occurring, when in fact it is not) and false negative errors (i.e., deciding that a potential source is not occurring, when in fact it is).

## 7.2 MEASUREMENT/DATA ACQUISITION

The measurement/data acquisition section of the QAP ensures that appropriate methods for sampling and analysis, quality control sampling, and data handling are employed through specifying methodologies for the collection, handling, and analysis of samples, as well as management of generated data (EPA, 1998b). Sampling locations, methodology, handling procedures, and analytical procedures for the CAMU groundwater monitoring are detailed above in Section 3.0. Quality control sampling, control limits, analytical considerations, and data management procedures are outlined below.

### 7.2.1 Quality Control Samples and Control Limits

Field quality control (QC) samples will be collected as outlined in Section 3.8, including one equipment rinsate blank, one deionized water blank, and one field duplicate sample per CAMU monitoring event.

Target control limits for field blanks (both deionized water and equipment rinsate blanks) are no contaminants present above laboratory detection limits. Target duplicate sample control limits for inorganic water constituents will be as follows (EPA, 2002): control limit of ±20% relative percent difference (RPD) for original and duplicate samples with concentrations

greater than five times the laboratory detection limit (DL); or control limit of  $\pm$  DL if the original or duplicate/split concentration is less than 5 times the DL. Relative percent difference is calculated as follows:

$$RPD = \frac{|S - D|}{\frac{(S+D)}{2}} \times 100$$

where RPD = relative percent difference (%)

S = original sample result; and

D = duplicate sample result.

Laboratory quality assurance and quality control will be maintained through adherence to the laboratory's internal quality assurance protocol during analysis. Lab QC sample frequency guidelines are specified in laboratory quality assurance (QA) plans.

Laboratory analysis for groundwater samples will include (at a minimum) the following types of QC samples:

- Laboratory preparation blanks;
- Matrix spike duplicates;
- Laboratory duplicates; and
- Laboratory control standards.

Target control limits for laboratory preparation blanks are no contaminants present above laboratory detection limits. Target laboratory duplicate sample control limits for inorganic constituents will be the same as those described above for field duplicates. Target control limits for matrix (pre-digestion) spike duplicates will be recovery in the range of 75 to 125%. Target control limits for laboratory control standards (LCSs) will be recovery in the range of 80 to 120%.

### 7.2.2 Instrument Maintenance and Calibration

Routine maintenance and calibration of field instruments (SC meter, dissolved oxygen meter, pH meter, etc.) will be accomplished through following manufacturer's recommendations and accepted field practice. Field instruments will be checked for proper performance prior to the initiation of field work. Backup instruments or provisions to obtain backup instruments at short notice should be in place prior to the initiation of field work to prevent loss of information due to instrument malfunction.

Calibration of laboratory instruments will be guided by the selected laboratory's internal quality assurance QA plan. Instrument calibration information will be retained by the laboratory and may be examined as necessary during the data review process.

Maintenance of laboratory instruments will be the responsibility of laboratory personnel, and will be conducted in such a manner as to minimize instrument downtime and interruption of analytical work. Trained staff will be responsible for routine maintenance; if major repairs become necessary, authorized technicians will be responsible for repairing instruments. The laboratory will archive maintenance records for all analytical instruments and will provide such information upon request.

In the event that analytical problems arise (e.g. matrix interferences or other problems), the laboratory will be responsible for notifying the project manager and QA/QC Officer. The resolution of analytical problems will be determined cooperatively by the project managers in consultation with the analytical laboratory.

# 7.2.3 Data Management and Documentation

Field data (including copies of field notebooks) will be reviewed for completeness and archived in the project file following completion of the field sampling event. Sample collection information will be checked to ensure that appropriate field parameter data have been collected for all sampling locations and that all samples have been collected as specified in the SMP and assigned appropriate sample numbers.

The laboratory will provide analytical data for samples in both hard copy and electronic format for transfer to a project-specific database. The laboratory will review data prior to submission to check for transcription errors, and to ensure that all required documentation is included in the submittal package. Documentation for analytical results will include, at a minimum:

- Chains-of-custody;
- Cover sheet indicating analysis;
- Tabulated analytical results;
- Tabulated reporting limits; and
- QC sample results.

The project database will be maintained in a format amenable to queries and reporting of data in common electronic or hard copy format (i.e., the database will be capable of generating spreadsheet tables, summary data reports, etc. as requested by project personnel).

#### 7.3 ASSESSMENT/OVERSIGHT

Regulatory personnel may provide oversight during implementation of the CAMU SMP. Agency approval of this SMP (following an initial review and comment period) will serve as the first step in ensuring the project is implemented in a manner consistent with the monitoring objectives. During the field sampling and analysis phase of the project, oversight personnel may conduct audits or assessments of field crews, equipment, record-keeping procedures, laboratory personnel or procedures, or other project team members at their discretion. Oversight personnel may also require the analysis of performance evaluation (PE) samples, and may request splits of any samples collected during the field efforts to verify the reliability of analytical data generated by the laboratory.

As data collected under the guidance of this SMP is received and reviewed, data summary and statistical reports will be prepared as described in Section 6.0 to advise project personnel of results, including QC results. Nonconformance with established quality assurance and/or quality control procedures for the project may result in corrective actions in the field or

laboratory. The scope of any corrective actions will depend on the particular violation of QA/QC protocols and the potential effects on the end use of the data. Examples of corrective actions are resampling of critical sites or reanalysis of particular parameters. Any corrective actions will be fully documented by field or laboratory personnel, and documentation will be retained in the project file.

### 7.4 DATA VERIFICATION AND USABILITY

A review of field and analytical data will be conducted following receipt of the laboratory data package. The data review will focus on the following QA/QC parameters:

- Completeness of sampling and analysis (correct number and types of samples collected, analyzed for the correct parameters);
- Completeness of field and laboratory documentation (information in field notebooks and on laboratory reports is complete and correct relative to project requirements);
- Holding times;
- Field QC sample results; and
- Laboratory QC sample results.

Data review procedures and application of data qualifiers will follow the general guidance given in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 2002), consistent with procedures currently used for review and qualification of the post-RI groundwater data. Data qualifiers will be assigned to data outside of target quality control criteria. A summary of the data qualifier codes is shown in Table 7-1.

Results of the data quality review will be included as part of the annual GMR submittal (Section 4.3). The primary focus of the data quality review will be an estimate of the effects any deviations from approved procedures may have on the project objectives or data uses.

7-7

#### 8.0 REFERENCES

- Asarco Consulting, Inc. (ACI), 2003. Phase I RCRA Facility Investigation Site Characterization Report, East Helena Facility. February 2003.
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- EPA, 1998a. EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5), EPA/600/R-98/018. Office of Research and Development, February 1998.
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- Hydrometrics, 1999. Current Conditions/Release Assessment, East Helena Facility. Revised January 1999.
- Hydrometrics, 2007a. Design Analysis Report, Asarco East Helena Corrective Action Management Unit (CAMU) Phase II Cell. Prepared for Asarco, LLC. January 2007.
- Hydrometrics, 2007b. Technical Inspection Report, Corrective Action Management Unit (CAMU) Phase I Cell, Asarco East Helena. Prepared for Asarco, LLC. Revised January 2007.

# **FIGURES**





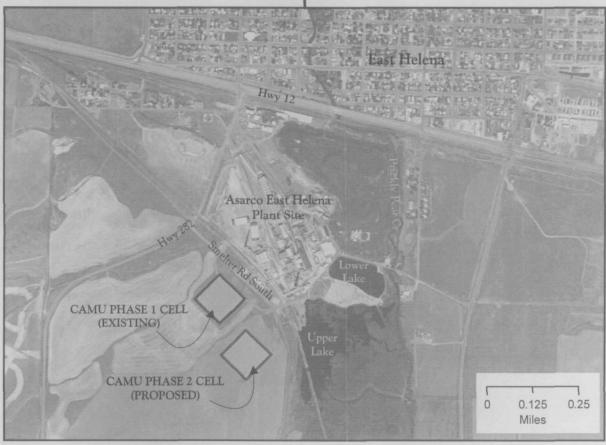
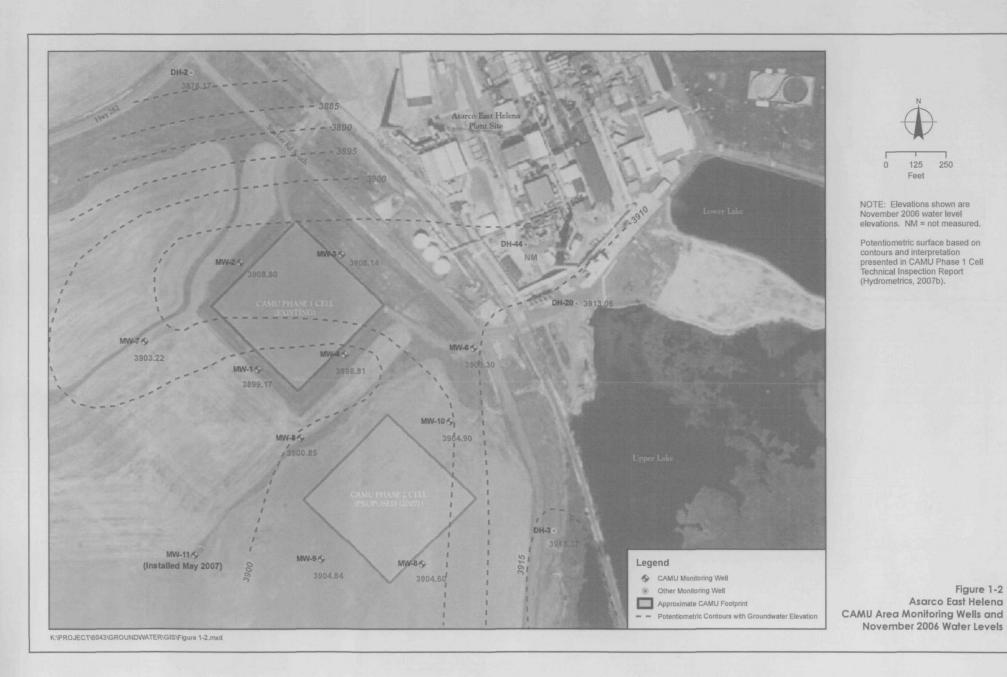


Figure 1-1 Asarco East Helena General Location Map



125 250 Feet

Figure 1-2

Asarco East Helena

# **TABLES**

TABLE 2-1. GROUNDWATER QUALITY OF ASARCO EAST HELENA CAMU MONITORING WELLS

Pa				Mor	itoring Loc	ation		
raran	neter/Statistic	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Numb	er of Samples	12	12	12	12	11	8	7
рН	average	7.15	6.92	6.90	7.21	7.45	6.96	7.46
, pn	standard deviation	0.61	0.44	0.38	0.59	0.59	0.57	0.86
SC	average	425	524	615	485	337	665	223
1 3	standard deviation	22	26	26	29	22	53	17
arsenic	average	0.005	0.012	0.011	0.004	0.007	0.159	0.017
arsenic	standard deviation	0.001	0.004	0.001	0.001	0.001	0.050	0.005
cadmium	average	0.0010	0.0010	0.0010	0.0011	0.0010	0.0010	0.0010
Cadmium	standard deviation	0	0	0	0.0003	0	0	0
200000	average	0.004	0.004	0.004	0.004	0.004	0.004	0.004
copper	standard deviation	0	0	0	0	0	0	0
lood	average	0.0052	0.0050	0.0050	0.0050	0.0050	0.0055	0.0050
lead	standard deviation	0.0006	0.0000	0.0000	0.0000	0.0000	0.0014	0.0000
ima	average	0.055	0.055	0.027	0.030	0.025	0.219	0.037
iron	standard deviation	0.088	0.082	0.016	0.024	0.010	0.037	0.021
	average	0.020	0.289	0.028	0.019	0.019	4.990	0.022
manganese	standard deviation	0.004	0.021	0.004	0.003	0.003	0.302	0.010
zinc	average	0.019	0.019	0.019	0.019	0.019	0.019	0.018
Zinc	standard deviation	0.003	0.003	0.003	0.003	0.003	0.004	0.004
calcium	average	48.0	72.8	84.6	58.2	38.4	93.6	18.7
Calcium	standard deviation	3.1	4.4	4.9	3.6	3.4	6.5	1.2
maanadum	average	10.2	16.2	19.3	12.4	7.8	20.3	5.5
magnesium	standard deviation	0.6	0.8	1.1	0.8	0.7	1.6	0.5
sodium	average	25.1	20.6	23.2	29.6	24.1	25.3	19.5
Socialii	standard deviation	1.2	1.0	1.3	1.7	1.4	1.8	1.5
n o to crium	average	5.1	5.3	6.0	6.4	4.7	5.2	5.1
potassium	standard deviation	0.2	0.5	0.6	0.7	0.5	0.4	0.2
sulfate	average	72.3	22.7	53.5	68.8	35.3	60.0	21.8
Suilate	standard deviation	8.2	7.6	9.4	10.9	9.0	26.4	5.4
chloride	average	13.2	6.4	10.3	9.8	6.9	9.4	2.5
CHOIGE	standard deviation	2.4	1.1	1.3	1.4	1.7	2.1	1.4
bicarbonate	average	150	298	311	206	166	351	109
Dicalbonate	standard deviation	21.7	6.8	8.1	12.0	10.3	6.7	5.4

NOTES: Concentrations are mg/L, except pH (s.u.) and SC (µmhos/cm).

Statistics based on Fall 2000 through Spring 2006 monitoring period.

Below laboratory detection limit values replaced with the laboratory detection limit for calculation of statistics.

Metals concentrations expressed as dissolved.

# TABLE 3-1. CAMU GROUNDWATER MONITORING WELL COMPLETION DETAILS

SITE	LOCATION	TOTAL DEPTH (ft bgs)	SCREENED INTERVAL (ft bgs)	TARGET AQUIFER	MEASURING POINT ELEVATION (ft amsl)
MW-1	Southwest of CAMU Cell 1	68	58-68	Volcanic Ash	3949.43
MW-2	Northwest of CAMU Cell 1	66	56-66	Volcanic Ash	3942.36
MW-3	Northeast of CAMU Cell 1	50	38.5-50	Volcanic Ash	3937.38
MW-4	Southeast of CAMU Cell 1	72	54-64	Volcanic Ash	3943.52
MW-5	Northwest of CAMU Cell 2	71	55-65	Volcanic Ash	3952.52
MW-6	East of CAMU Cell 1	40	30-40	Shallow Alluvium	3934.54
MW-7	West of CAMU Cell 1	60	44-59	Volcanic Ash	3959.99
MW-8	Southeast of CAMU Cell 2	70	44.5-64.5	Volcanic Ash	3954.97
MW-9	Southwest of CAMU Cell 2	70	50-70	Volcanic Ash	3961.72
MW-10	Northeast of CAMU Cell 2	70	42-62	Volcanic Ash	3942.60
MW-11	West of CAMU Cell 2	70	50-70	Volcanic Ash	Survey Pending

ft bgs = feet below ground surface ft amsl = feet above mean sea level

# TABLE 3-2. CAMU GROUNDWATER MONITORING SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Matrix	Parameter(s)	Filtration	Container	Preservation
Water	Dissolved Metals	Yes (0.45-μm filter)	500 mL polyethylene	HNO₃ to pH <2; cool to 4°C
	Major Cations/Anions and Physical Parameters	No	1000 mL polyethylene	Cool to 4°C

TABLE 3-3. CAMU GROUNDWATER ANALYTICAL PARAMETER LIST

Parameter	Parameter Analytical Method <sup>(1)</sup>		
	Field Parameters	(mg/L)	
рН	Field SOP	None	
Specific conductance	Field SOP	None	
Dissolved oxygen	Field SOP	None	
Water temperature	Field SOP	None	
Water level	Field SOP	None	
	Laboratory Parameters		
Major Cations/Anions and Physi	ical Parameters		
Calcium (Ca)	215.1/200.7	5	
Magnesium (Mg)	242.1/200.7	5	
Sodium (Na)	273.1/200.7	5	
Potassium (K)	258.1/200.7	5	
Sulfate (SO4)	300.0	1	
Chloride (Cl)	300.0	1	
Total alkalinity as CaCO <sub>3</sub>	310.1	5	
Total dissolved solids	160.1	10	
Specific Conductance	120.1	None	
Metals (Dissolved) Aluminum (Al)	200.7/200.8	0.1	
Antimony (Sb)	200.7/200.8	0.005	
Arsenic (As)	200.7/200.8	0.005	
Arsenic III/V	E 1632A M	0.005	
Barium (Ba)	200.7/200.8	0.1	
Beryllium (Be)	200.7/200.8	0.001	
Cadmium (Cd)	200.7/200.8	0.001	
Chromium (Cr)	200.7/200.8	0.001	
Cobalt (Co)	200.7/200.8	0.01	
Copper (Cu)	200.7/200.8	0.004	
Iron (Fe)	200.7/200.8	0.02	
Lead (Pb)	200.7/200.8	0.005	
Manganese (Mn)	200.7/200.8	0.015	
Mercury (Hg)	200.8/245.1	0.006	
Nickel (Ni)	200.7/200.8	0.01	
Selenium (Se)	200.7/200.8	0.005	
Selenium IV/VI	SM 3114B M	0.005	
Silver (Ag)	200.7/200.8	0.005	
Thallium (Tl)	200.7/200.8	0.002	
Tin (Sn)	200.7/200.8	0.1	
Vanadium (V)	200.7/200.8	0.01	
Zinc (Zn)	200.7/200.8	0.02	

NOTES: (1) Field Standard Operating Procedures (SOPs) approved for previous work at the Asarco East Helena Site will be used as guidance for collection of field water quality parameters. Laboratory analytical methods are from EPA's Methods for Chemical Analysis of Water and Wastes (1983); supplemental EPA methods (E), or Standard Methods for the Examination of Water and Wastewater (SM). M = modified.

TABLE 3-4. CONCENTRATION LIMITS FOR CONSTITUENTS OF CONCERN

	Well-Specific Concentration Limits (mg/L)							
Parameter	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	
Arsenic (As)	0.008	0.019	0.013	0.015	0.009	0.254	0.027	
Cadmium (Cd)	0.001	0.001	0.001	0.003	0.001	0.001	0.001	
Copper (Cu)	0.004	0.004	0.004	0.004	0.004	0.012	0.004	
Iron (Fe)	0.06	0.06	0.06	0.06	0.06	0.29	0.08	
Lead (Pb)	0.015	0.005	0.005	0.015	0.005	0.015	0.005	
Manganese (Mn)	0.045	0.336	0.036	0.015	0.045	5.55	0.045	
Zinc (Zn)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	

NOTE: Concentration limits derived from existing metals data set for each well as follows:

- [1] If all data below reporting limits, concentration limit set at the PQL (Table 3-3). These parameters denoted in **bold type**.
- [2] If >50% of data below reporting limits, concentration limit set at 3x the PQL (Table 3-3). These parameters denoted in *italic type*.
- [3] If <=50% of data below reporting limits, concentration limit set at the average plus two standard deviations. These data denoted in normal font.

# TABLE 7-1. DATA VALIDATION CODES AND DEFINITIONS

CODE	DEFINITION					
J -	The associated numerical value is an estimated quantity because quality control criteria were not met.					
	Subscripts for the "J" qualifier:					
	2- Deviation from required calibration procedures, calibration range exceeded, or poor recovery on a known standard. Possible bias.					
	3- Holding time not met. Indicates possible low bias.					
	4- Other quality control outside control limits.					
UJ -	The "U" indicates that the material was analyzed for, but was not detected. The "J" indicates that the associated value is an estimate. Subscripts for the "UJ" qualifier are applied as follows:					
	1- Blank contamination. Indicates possible high bias and/or false positive					
	2- Deviation from required calibration procedures, calibration range exceeded, or poor recovery on a known standard. Possible bias.					
	3- Holding time not met. Indicates possible low bias.					
	4 - Other quality control outside control limits.					
R-	Quality control indicates that the data are unusable (compound may or may not be present). Resampling and/or reanalysis is necessary for verification.					
L	present). Resampting and/or realizings is necessary for verification.					

# ATTACHMENT A

**MONITORING WELL LOGS** 

# Hydrometrics, Inc. Consulting Scientists and Engineers

Helena, Montana

Well Log and Construction Diagram

Hole Name: MW-1

Date Hole Started: 6/25/97 Date Hole Finished: 6/26/97

INTERVAL +1.9-68.0

+2.0 - 3.0

58.0 - 68.0

55.0 - 68.0

0.0 - 1.0

1.0 - 51.0, 51.0 - 55.0

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana

Property Owner: Asarco Inc.

Legal Description: NE, SW Section 36, T10N, R3V

Location Description:

Recorded By: John Ruth

Drilling Company: O'Keele Drilling

Driller: Dan Duran

Drilling Method: Air Rotary with casing drive

Drilling Fluids Used: None

Purpose of Hole: Groundwater monitoring well

Target Aquilor: First Water Hole Diamoter (in): 7 Total Depth Drilled (ft): 68

WELL COMPLETION	YN	DESCRIPTION
Well Installed?	Y	2-inch PVC casing

Surface Casing Used? Y 6-inch steel Screen/Perforations? 0.010 slot PVC screen

Sand Pack? 10-20 silica sand Annular Seal? Bentonite grout, bentonite chips

Cement pad Surface Seal?

**DEVELOPMENT/SAMPLING** Well Developed?

Water Samples Taken? N

Boring Samples Taken? Y lithologic identification

Northing: 9145.74

Static Water Level Below MP: 50.21

Date: 7/21/00

MP Description: Top of PVC

MP Height Above or Below Ground (ft): 1.65

Easting: 7019.35

Surface Casing Height (ft): 2.0

Riser Height (ft): 1.88

Ground Surface Elevation (ft): 3947.78

MP Elevation (ft): 3949.43

Continued Next Pago

Sheet 1 of 2

Remarks: Drilling performed with a Drilltech DH40 air rotary with casing drive drilling rig.

# WELL CONSTRUCTION RAPHIC SAMPLE GEOLOGICAL DESCRIPTION **NOTES** ₼ 0.0 - 5.0' Sitty Clay Light brown, tan, soft, trace coarse grained sand, dry, loose, trace rounded line Ground Surace Cement 1.0 Surface Scal Bentonite Grout 5.0 - 10.0' Silty Clay As above, greding to clayoy six (ML) in part, very slightly moist, trace coarse grain cond, very soft, low plasticity. 10.0 - 15.0' Sitty Clay As above, grading to clayey silt (ML), trace coarse send and fine gravel. 15.0 - 20.0' Silty Clay As above, grading to clayey sit (ML), slightly darker brown, very slightly moist to dry. 20.0 - 25.0' Silty Clay Rust brown becoming gravelly with 1/4 - 1/2" size gravel. 25.0 - 30.0" Sandy Gravel 1/4 - 3/4" size gravel, angular, trace subrounded, basalt, quartizite, line to 1054.GPJ HYDHLNI.GOT 9/20/00 coarse sand, unconsclidated, dry. 30.0 - 38.0' Sandy Gravel As above, angular tine gravel, tough drilling. 35.0 - 40.0' Gravelly Silty Clay Orange brown, 8% line angular gravel, 10% line to coarse grain sand, very slightly moist, unconsolidated, low plasticity. REV4 STANDAND

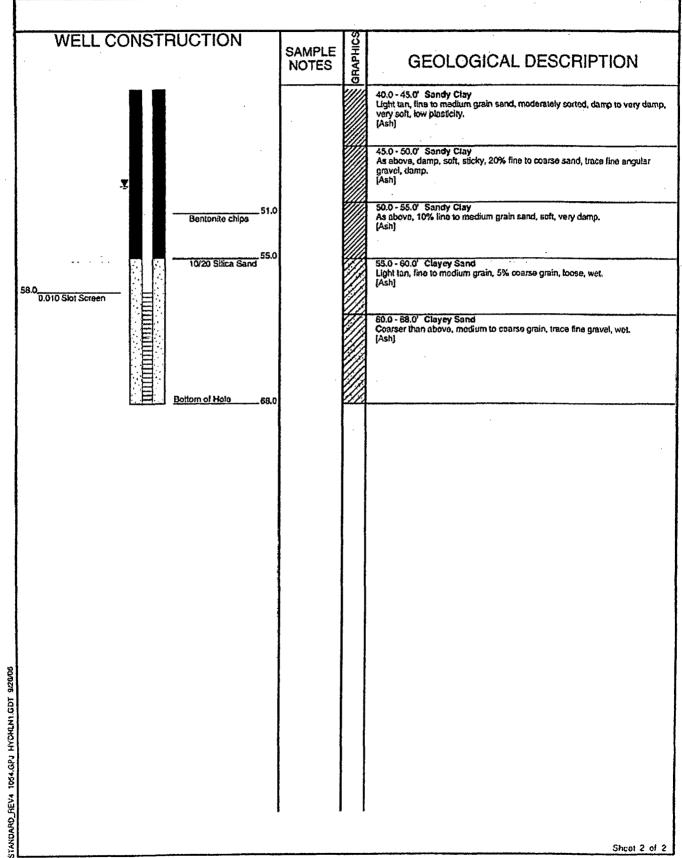
Hydrometrics, Inc. - Consulting Scientists and Engineers

Helena, Montana

Well Log and Construction Diagram

Hole Name: MW-1





# Hydrometrics, Inc. — Consulting Scientists and Engineers

Well log and construction diagram

Hole Name: MW-2

Date Hole Started; 6/28/97 Date Hole Finished: 6/27/97

INTERVAL

+1.9-66.0

+2.0 - 3.0

56.0 - 66.0

53.0 - 66.0

0.0-1.0

1.0 - 49.0, 49.0 - 53.0

Helena, Montana

Project: Interim Measures East Helena Facility
County: Lewis and Clark State: Montana

Property Owner: Asarco Inc.

Legal Description: NE, SW Section 36, T10N, R3W

**Location Description:** 

Recorded By: John Ruth/John Ballantyne Drilling Company: O'Keele Drilling

Driller: Dan Duran

Drilling Method: Air Rotary Drilling Fluids Used: Water

Purpose of Hole: Water quality monitoring

Target Aquifer: First Water Hole Diameter (in): 7 Total Depth Drilled (ff): 66

Sand Pack?	Y	10-20 silica sand
Annular Seal?	. Y	Bentonite grout, bentonite chips

Surface Seal? Y

WELL COMPLETION Y/N

Surface Casing Used? Y

Screen/Perforations?

Well Installed?

DEVELOPMENT/SAMPLING
Well Developed? N

Water Samples Taken? N

Boring Samples Taken? Y lithologic Identification

Northing: 9564.62

Proge Cabbing, coor.

DESCRIPTION

0.010 slot PVC screen

6-inch steel

Cement pad

2-inch, flush threaded, Sch 40, PVC

Static Water Level Below MP: 35.01

Date: 7/21/00

MP Height Above or Below Ground (ft): 1.79

MP Description: Top of PVC

Easting: 6981.24
5.01 Surface Casing Height (ft): 2

Continued Next Page

Sheet 1 of 2

Riser Height (ft): 1.87

Ground Surface Elevation (ft): 3940,57

MP Elevation (ft): 3942.36

Remarks:

# WELL CONSTRUCTION SAMPLE **GEOLOGICAL DESCRIPTION NOTES** 0.0 - 5.0' Clayoy Gravelly Sand .../Coment surface seab Light brown, fine to coarse sand, loose, slightly moiet, 5% fine gravel, Bentonito Grout 1.0 subrounded. S.0 - 10.0° Sandy Sitty Clay Orange, brown, soft, slightly moist, 35% line to medium grained sand, trace coarso grained, trace fine gravel. 10.0 - 15.0' Silty Clay Orange brown, low plasticity, grading to clayey silt, very slightly moist, trace sand and fine gravel. 15.0 - 20.0' Silty Clay As above. 20.0 · 25.0' Slity Clay Orange, brown, 5% fine to coarse sand, trace line gravet, low plasticity, slightly 25.0 - 30.0' Sandy Gravel Gray, black, rod brown, 1/4 - 3/4", angular to subrounded, 15% fine to coarse grain sand, dry, unconsolidated. 1094.GPJ HYDIGN1.GDT 30.0 - 34.0" Sandy Gravel Fine gravel as above, subangular, predominantly besult, timestone and quartzite, loose, dry, hard draing. Ó 34.0 · 40.0" Silly Clay Tannish white, changing to orange brown, low plasticity, soft, trace fine to medium grain sand, very moist to damp. [Ash]

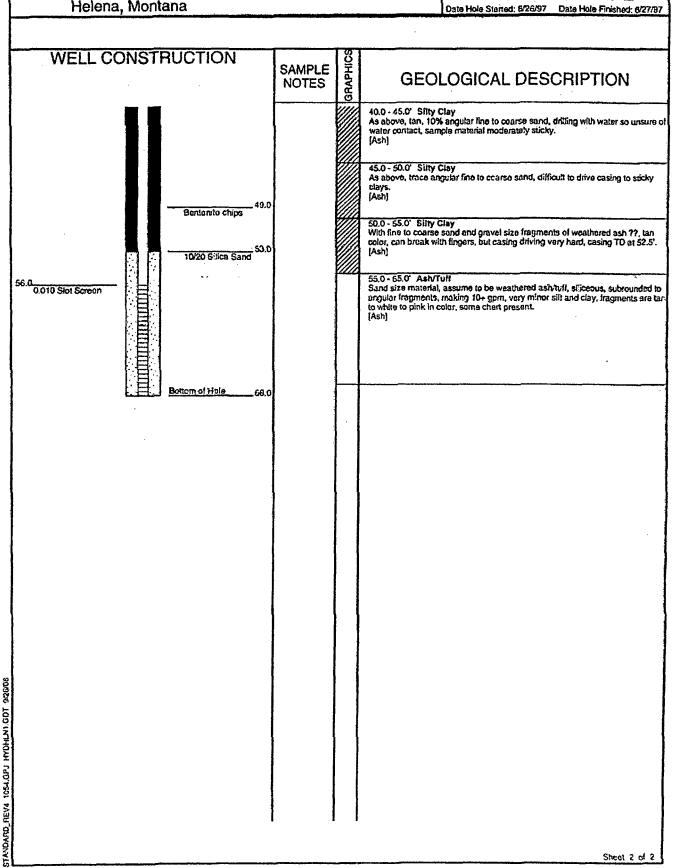
Hydrometrics, Inc. Consulting Scientists and Engineers



Helena, Montana

Well log and construction diagram

Hole Name: MW-2



Hydrometrics, Inc. Consulting Scientists and Engineers

Well log and construction diagram

Hole Name: MW-3

38.5 - 48.0

Helena, Montana Date Hole Started: 6/27/97 Date Hole Finished: 6/30/97 WELL COMPLETION YM DESCRIPTION INTERVAL

Υ

Y

Υ

Client: ASARCO, INC. Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana Property Owner: Asarco Inc.

Screen/Perforations? Legal Description: NW, Sw, Section 36, T10N, R3/V Sand Pack? Annular Seal?

Location Description:

Recorded By: JB/GH

Drilling Company: O'Keele Drilling

Driller: Dan Duran Drilling Method: Air Rotary Drilling Fluids Used: Water

Purpose of Hole: Water quality monitoring

Target Aquifer: First Water Hole Diameter (in): 7 Total Depth Orilled (it): 50

Water Samples Taken? N

Northing: 9585.79

Date: 7/21/00

Well Installed?

Surface Seal?

Well Developed?

Surface Casing Used? Y

**DEVELOPMENT/SAMPLING** 

Boring Samples Taken? Y

MP Description: Top of PVC

MP Height Above or Below Ground (It): 1.54

2-Inch, flush threaded, Sch 40, PVC +2.3 - 48.0 6-inch steel +2.5 - 2.5

0.010-inch slot, Sch 40, PVC 10-20 silica sand

37.0 - 48.0 Bentonite Grout, 3/8° bentonite chips 1.0-33.0, 33.0-37.0

0.0-1.0 Cement pad

lithologic identification Easting: 7367.42

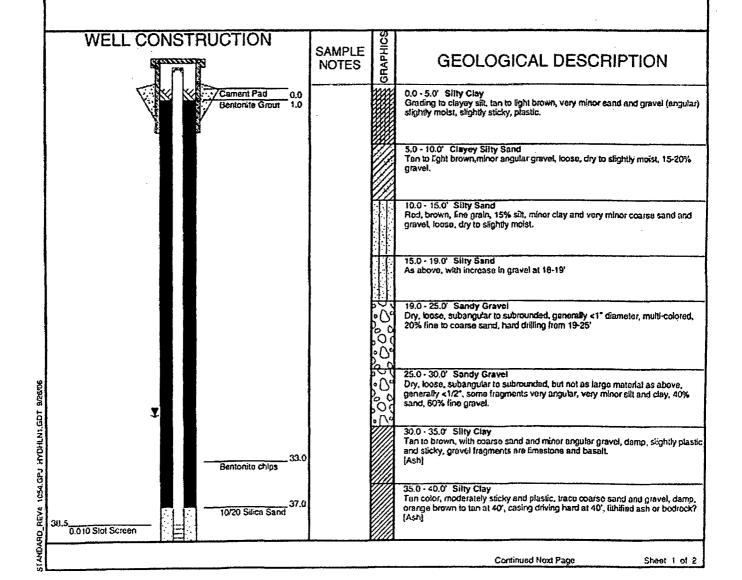
Static Water Level Below MP: 30.49 Surface Casing Height (ff): 2.50

Riser Height (ft): 2.31

Ground Surface Elevation (ft): 3935.84

MP Elevation (ft): 3937.38

Remarks:



Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana

Well log and construction diagram

Hole Name: MW-3
Date Hole Started: 6/20/97
Date Hole Finished: 6/30/97 WELL CONSTRUCTION GRAPHICS SAMPLE NOTES **GEOLOGICAL DESCRIPTION** 40.0 - 45.0' Clayoy Sand Fine to coarse sand, subangular to subrounded, wet. [Ash] 45.0 - 50.0° Clayey Sand As above, water free in hole, 15% gravel, coarse, subsounded. (Ash) Bottom of Hole

# Hydrometrics, Inc. Consulting Scientists and Engineers

Helena Montana

Total Depth Drilled (ft): 72

Remarks: Depth water encountered: 52'

Monitoring well

Hole Name: MW-4

MP Elevation (ft): 3943.52

Continued Next Page

Sheet 1 of 2

nelella, Molitalia			Date Hole Started: 5/8/200	O Date Hole Finished: 5/10/00
Client: ASARCO, INC.	WELL COMPLETION	Y/N	DESCRIPTION	INTERVAL
Project: Interim Measures East Helena Facility	Well installed?	Y	2-Inch, flush threaded, Sch 40, PVC	+2.6-72
County: Lewis and Clark State: Montana	Surface Casing Used?	Y	5-inch steel	+3 to -2
Property Owner: Asarco Inc.	Screen/Perforations?	Y	0.010-inch slot, Sch 40, PVC	54-64
Legal Description: NW, NW, SE, Sec. 36 T10N, R	WSand Pack?	Y	10-20 silica sand	50-70
Location Description:	Annular Seal?	Y	Bentonite Pellets/Bentonite Grout	48-50 pellets, 1-48 grout
·	Surface Seal?	Y	Cement	0-1
Recorded By: JR	DEVELOPMENT/SAME	PLING	•	
Drilling Company: Hydrometrics, Inc.	Well Developed?	Y	pumping	
Driller: Ron Meinstma	Water Samples Taken's	? Y	common ions, metals	
Drilling Method: Air Rotary/ODEX	Boring Samples Taken	? Y	lithologic identification	
Orilling Fluids Used: Water(approximately 200 gall	onbiorining: 9179,4484		Easting: 7414.9809	
Purpose of Hole: CAMU Monitoring Well	Static Water Level Belo	w MP:	45.26 Surface Casing	Height (ft): 2.6
Target Aquifer: First Water	Date: 7/21/00		Riser Height (ft)	: 2.4
Hole Diameter (in): 6	MP Description: Top o	I PVC	Ground Surface	Elevation (ft): 3941.08

MP Height Abova or Below Ground (ft): 2.44

WELL CONSTRUCTION GRAPHIC SAMPLE GEOLOGICAL DESCRIPTION **NOTES** 0.0 - 5.0° Sitt Tan, whitish ten, denso. Bentonite Grout 0.5 5.0 - 7.0' Sin Whitish tan, trace clayey, no plasticity, dense, trace fine gravel, formation is dry, driller adding some water. 7.0 - 10.0' Silt Whitish tan, trace clayey, no plasticity, dense, trace line gravel, formationis de drifter adding some water. Whilish ten, trace dayey, no plasticity, dense, trace line gravel, formation is dry, drifter adding some water. Clavey six from 10-10.5' 12.0 - 15.0' Silt Whilsh tan, trace dayey, no plasticity, dense, trace fine gravel, formation is Whitsh (an, trace cayey, no pasticny, dense, trace and gravet, formation is thy, dniller pitching some writer.

15.0 - 17.0" Sill/Gravetly Silt
Silt as above, tan, fightish brown, slightly clayey, changing to gravetly sand at 16", dry, unconsolidated, abundant coboles.

17.0 - 20.0" Gravetly Sand
Light brown, line grain - 10%, medium grain, moderately sorted, 35% fine travet, processionated, abundant 3-4" gravets and coboles. 20.0 - 22.0' Gravets
Gray, medium sized 1/2 to 1' in size, abundant cobbles 3-5', difficult drilling, 20% fine grein sand, dry. 22.0 - 31.0° Sandy Gravels As above, gravels and cobbles dry.

31.0 - 40.0' Ash-Silty
Tan, black flocks, blotts(?), basalt fragments (?), loase to medium donso. Y moderately cemented in part dry, becoming moist at 39', 40.0 - 42.0' Ash-Silty Bentonite Pallets 50.0 Tan, speckled black, moderately to well comented, dense to hard, dry to moi 10/20 Silica Sand (Ash) 42.0 - 50.0' Ash-Silty TOS. CAP. HYDHLAS. GOT As above, tan, specided black, dense to hard, driller adds water. 50.0 - 52.0' Ash-Silty Sandy Tan, very line to line grain. 10% medium to coarse grain, poorly sorted, firm 30% silt, appears to be weathered ash, making 6 gpm. [Ash] 52.0 - 60,0° Ash w/Gravel 64.0 Slough Black, brown, fine to coarse grain, difficult drilling, driller adding water. 60.0 - 62.0' Ash-Clayey Sandy Brown, tan, mottled yellow and white, very fine to fine grain, 5% clayey, non-plastic, 5% medium grain, moderately to well sorted, firm, moist, driller Bottom of Hole 72.0 adding water. Coarse sand at top of spoon, may be washed slough. GFANDARD

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana

Monitoring well

Hole Name: MW-4
Date Hole Started: 5/8/2000 Date Hole Finished: 5/10/00

WELL CONSTRUCTION	SAMPLE NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
•		Ů	Ashl 62.0 - 70.0° Ash-Sandy Silt Tan, yellow, white, 20% very fine to fine sand, 3% medium to coarse sat sorted firm, no plasticity, moist, driller adding water, abundant mica.
			[Ash]  As above.  [Ash]

Total Depth Drilled (ft): 71

Hydrometrics, Inc. Consulting Scientists and Engineers

Monitoring well

Hole Name: MW-5

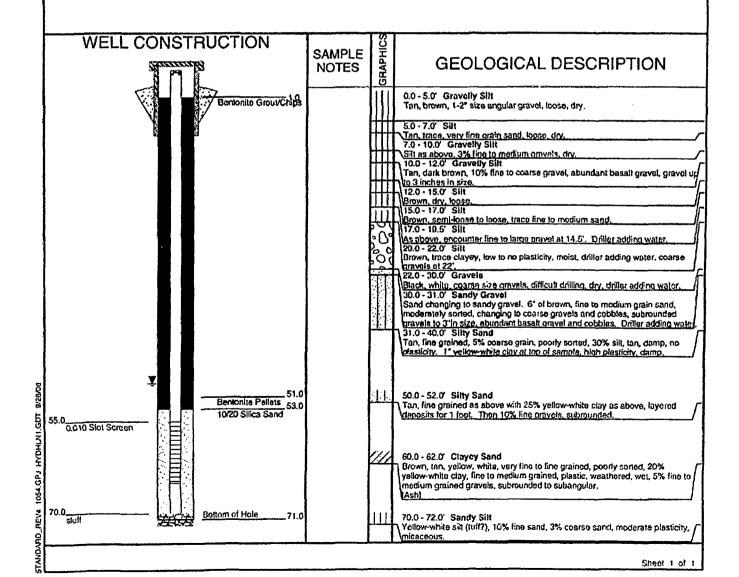
Date Hole Started: 5/11/2000 Date Hole Finished: 5/12/200

MP Elevation (ft): 3952,52

Helena, Montana Client ASARCO, INC. WELL COMPLETION DESCRIPTION YM INTERVAL 2-inch, flush threaded, Sch 40, PVC Project: Interim Measures East Helena Facility Well Installed? +2.9-65 Surface Casing Used? Υ 5-Inch steel +3 to -2 County: Lewis and Clark State: Montana 0.010-inch slot, Sch 40, PVC Screen/Perforations? Y 55-65 Property Owner: Asaroo Inc. Legal Description: NE, NE, SW, Sec. 36 T10N, R3WSand Pack? 10-20 sitica sand Y 53.70 Bentonite Pellets Location Description: Annular Seal? 6-51 grout, 51-53 chips Surface Soal? Cement **DEVELOPMENT/SAMPLING** Recorded By: JR Well Developed? pniamua Drilling Company: Hydrometrics, Inc. Water Samples Taken? Y Driller: Ron Meinstma common lons, metals Drilling Method: Air Rotary/ODEX Boring Samples Taken? Y lithologic identification Drilling Fluids Usod: Water(approximately 80 gallons)Northing: 8841.6307 Easting: 7219.2612 Static Water Level Below MP: 51.64 Surface Casing Height (ft): 3.0 Purpose of Hole: CAMU Monitoring Well Target Aquiler: First Water Date: 7/21/00 Riser Height (ft): 2.9 Hole Diameter (in): 6 MP Description: Top of PVC Ground Surface Elevation (ft): 3949.62

MP Height Above or Below Ground (it): 2.90

Remarks: Samples collected with 3-inch diameter spoons on 2 7/8-inch rods, driven by a 300 lb/30-inch drop auto hammer.



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Helena. Montana

Hole Diameter (in): 8

Total Depth Drilled (ft): 40%

Monitoring well

Hole Name: MW-6

Ground Surface Elevation (ft): 3931.92

Sheet 1 of 1

MP Elevation (ft): 3934.54

Date Hole Started: 5/13/2000 Date Hole Finished: 5/14/200 WELL COMPLETION Client ASARCO, INC. DESCRIPTION YN INTERVAL 2-inch, flush threaded, Sch 40, PVC We'll Installed? Project: Interim Measures East Helena Facility +2.6-40 County: Lewis and Clark State: Montana Surface Casing Used? Y 5-inch steel +3 tp -2 0.020-inch slot, Sch 40 PVC Screen/Perforations? 30-40 Property Owner: Asarco Inc. Legal Description: NW, NW, SE, Sec. 36 T10N, R3WSand Pack? 10-20 silica sand 22-40 Annular Seal? Bentonite Pellets/Bentonite Grout 24-27 pellets, 1-24 grout Location Description: Surface Seal? Cement DEVELOPMENT/SAMPLING Recorded By: JR Well Developed? pumping Drilling Company: Hydrometrics, Inc. Water Samples Taken? Y common lons, metals Driller: Ron Meinstma Drilling Method: Air Rotary/ODEX Boring Samples Taken? Y lithologic identification Easting: 7920.5073 Drilling Fluids Used: Water(approximately 40 gallohe)Northing: 9236.7837 Purpose of Hole: CAMU Monitoring Well Static Water Level Below MP: 26..68 Surface Casing Height (ft): 2.8 Date: 7/21/00 Riser Height (ft): 2.6 Target Aquiler: First Water

Remarks: Samples collected with 3-inch diameter spoons on 2 7/8-inch rods, driven by a 300 lb/30-inch drop auto hammer.

MP Description: Top of PVC

MP Height Above or Below Ground (ft): 2.62

### WELL CONSTRUCTION GRAPHIC SAMPLE GEOLOGICAL DESCRIPTION **NOTES** Cement 0.0 - 5.0' Gravelly Silty Sand Bentonite Grout Brown, tan, very fine to fine grained, 15-20% silt, 15% fine angular gravel, dry. Oritler adding water. 5.0 - 7.0' Clayey Sift White, black specifies, resembles weathered volcanic ash, 2" of brown, gravelly silt, moist, poor split spoon recovery. 7.0 - 10.0' Sandy Gravelly Slit Brown, tan, 15% very fine grain sand, 10% fine to medium sized gravel, dry. 10.0 - 12.0' Gravelly Silt Brown, gray, orango brown, 10% fine grain sand, fine to coarse gravel, trace pobbles, gravel to 3° in size, dry. 12.0 - 15.0' Gravelly Sand Brown, tan, fine to coarse sand, poorly sorted, fine to medium size gravel, loose, unconsolidated, druler adding water, 15.0 - 17.0' Gravelly Sand Brown, orange brown in part, fine to medium grain, moderately sorted, 25% coarse to modium size gravel, subtounded, unconsolidated, do 17.0 - 20.0' Gravelty Sand As above, slightly coarse, line to coarse grain, 10% coarse grain, poorly sorteg unconsolidated, dry, 20.0 - 22.0 Clayey Sitt Light Ian, motified green, black speckled, orange brown from 21-22. Appears to be weathered, volcanic ash, no plasticity, moist, dense, driller adding water. Bentonite Pallets YASHL 10/20 Siaca Sand 30.0 0,010 Slot Screen 30.0 - 32.0' SIII Brown, speckled, black, very moist, dense, crumbly, no planticity, borehole making approx. 1 gpm. HYDHUN1,GUT 38.0 - 40.0' Sandy Gravels Brown, black, 1/4 - 1/2' size gravels in cuttings, borehole making 30-40 gpm. **Bottom of Hale** 40.0 40.0 · 42.0' Silty Sand Brown, fine grain, 8% coarse grain, weakly cemented, 35% silt, borehole PEVA making approx. 40 gpm. STANDARD

# Hydrometrics, Inc. . Consulting Scientists and Engineers



Helena, Montana

Monitoring well

Hole Name: MW-7 Date Hole Started: 5/16/2000 Date Hole Finished: 5/18/200

WELL COMPLETION DESCRIPTION Client: ASARCO, INC. YN INTERVAL 2-inch, flush threaded, Sch 40, PVC +2.3.59 Well Installed? Project: Interim Measures East Helena Facility +3 to -2 Surface Casing Used? Y 5-inch steel State: Montana

County: Lewis and Clark 0.010-inch slot, Sch 40, PVC 44-57 Screen/Perforations? Υ Property Owner: Asarco Inc. Legal Description: NW, NE, SW, Sec 36 T10, R3W Sand Pack? 10-20 silica sand 42-59

Annular Seat? Bentonite Pellets/Bentonite Grout 39-42 pellets, 1-39 grout Location Description:

Surface Seal? Cement

**DEVELOPMENT/SAMPLING** Recorded By: JR

Well Dovoloped? Drilling Company: Hydrometrics, Inc. Υ pumping

Water Samples Taken? Y common ions, metals Driller: Ron Meintsma lithologic Identification Drilling Method: Air Rotary/ODEX Boring Samples Taken? Y

Easting: 6565.4048 Drilling Fluids Used: Water(approximately 100 gallphstorthing: 9235.2585

Purpose of Hole: CAMU Monitoring Well Static Water Level Below MP: 54.88 Surface Casing Height (It): 2.5 Date: 7/21/00 Riser Height (ft): 2.3 Target Aquifor: First Water

MP Description: Top of PVC Ground Surface Elevation (ft): 3957.69 Hole Diameter (in): 6

MP Elevation (ft): 3959.99 MP Height Above or Below Ground (ft): 2.3 Total Depth Drilled (ft): 60

Remarks: Samples collected with 3-inch diameter spoons on 2 7/8-inch rods, driven by a 300 lb/30-inch drop auto hammer.

## WELL CONSTRUCTION GRAPHIC SAMPLE GEOLOGICAL DESCRIPTION **NOTES** 0.0 - 5.0' Gravelly Sand ·/Cement 0.0 Brown, fine to coarse grain, poorly sorted, loose, dry, 15-20% fine to medium Grout 1.0 size gravel, angular. 5.0 - 7.0' Gravelly Sand As above, fine to coarse grain, poorly sorted, 15-20% fine to medium size angular gravel; driller adding water. 7.0 - 10.0° Gravelly Sand As abovo. 10.0 - 12.0 Gravelly Sand As above, brown, fine to coarse grain, poorly sorted, 15% fine to medium size gravel, subangular, 5% coarse gravel and combles, 12.0 - 14.0' Gravelly Sand As abovo, 20% fine to coarse size gravel. Brown clay from 14-15'. 15.0 - 17.0' Silt Oživo tan, v. fine sandy to clayey texture, medium dense, trace black sockles. appears to be weathered ash, moderately sorted from 15-15.5°; driller adding Top of Ash at 14" As above, appears to be weathered volcanic ash 20.0 - 22.0' Slit Olive tan, orange brown, speckled black in part, hard and brittle in part, appear to be volcanic ash, changing to dense and firm, borehole, making trace water 1 onVmin. Olive tan, white and tan, speckled black, clayey in part, britle to soft, low 1064.GPJ HYDHLN1.GDT Olive brown, 5% fine grain sand, dense, firm-soft, trace brittle, appears to be weathered volcanic ash 32.0 - 40.0° Silt As above, soft to brittle, difficult drilling, drilliar adding water, trace sand and STANDARD HEVA Bentonite pellets

Continued Next Page

Sheet 1 of 2

Monitoring well Hydrometrics, Inc. Consulting Scientists and Engineers Hole Name: MW-7 Helena, Montana Date Hole Started: 5/16/2000 Date Hole Finished: 5/18/200 WELL CONSTRUCTION GRAPHIC SAMPLE **GEOLOGICAL DESCRIPTION NOTES** 40.0 - 42.0' Sandy Silt Olive brown, six with 15% line grain sand size material, clayer in pan, changing to sixy sand, predominantly fine grain sand sixy sand, predominantly fine grain sand size material, clayer in pan, changing to sixy sand, predominantly fine grain sand size material, clayer in pan, changing to sixy sand, predominantly fine grain sand, very difficult drilling, seems well 10/20 Silica Sand 50.0 - 52.0' Sandy Silt Orange brown, tan, time green, 10% line to coarse sand, firm, dense to very dense, borehote making less than 1 gpm, dense from 50-50,5', 52,0 - 60.0' Sandy Sitt

Tan, light brown, 10% very fine grain sand, weakly camented, firm, trace dayay, wet. 59.0 Bottowiol Holo 60.0 60.0 - 62.0° Silty Sand/Sandy Silt Silty, very fine to machium grained sand sized material in sit, 20-30% moist, grading to sandy silt with clay and pea gravel at 61°. Sample more heterogeneous below 81° and stratified, some minor orange layers 4 mm thick overall color light brown-cream.
[Volcanic Ash]

# Hydrometrics, Inc. Consulting Scientists and Engineers

Helena, Montana

Monitoring well

Hole Name: MW-8

Date Hole Started: 9/25/08 Date Hole Finished: 9/26/06

INTERVAL

+2.12 - 64.5

+2.41 - 2.59

44.5 - 64.5

42-70

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana

Property Owner: Asarco Inc.

Legal Description: Sec 36 T10N, R3W

Location Description:

Recorded By: John Borgin Drilling Company: Boland Drilling

Driller: Rick & Chuck

Drilling Method: Air Rotary/ODEX Drilling Fluids Used: Air/water

Purpose of Hole: Groundwater Monitoring Well

Target Aquifer: First Water Hole Diameter (in): 4 Total Depth Drilled (ft): 70

Annular Seal? Surface Seal?

WELL COMPLETION

Surface Casing Used?

Screen/Perforations?

Well Installed?

Sand Pack?

Cement

DESCRIPTION

10-20 silica sand Bentonite Chips

0.020-inch slot. Sch 40 PVC

2-inch, flush threaded, Sch 40, PVC

0.5-42 0.0.5

**DEVELOPMENT/SAMPLING** 

Well Developed? Bailer/pump

Water Samples Taken? N

Boring Samples Taken? Y lithologic identification

YAN

Northing: 8376.8943

Easting: 7685.1041 Static Water Level Below MP: 50.91

Surface Casing Height (fi): 2.41

Date: 11/2/06

Riser Height (ft): 2.12

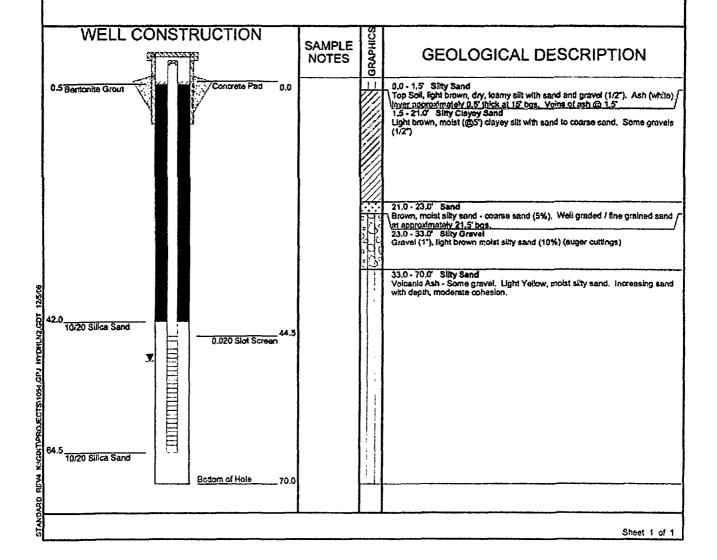
MP Description: Top of PVC

Ground Surfaco Elevation (ft): 3952.82

MP Height Above or Below Ground (ft): 2.12

MP Elevation (ft): 3954.97

Remarks:



# Hydrometrics, Inc. Consulting Scientists and Engineers

Monitoring well

Hole Name: MW-9

INTERVAL

+2.77 - 2.33

+1.83-70

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility State: Montana County: Lewis and Clark

Helena, Montana

Property Owner; Asarco Inc.

Legal Description: Sec 35 T10N, R3W

Location Description:

Recorded By: John Bergin Drilling Company: Boland Drilling

Driller: Rick & Chuck

Drilling Method: Air Rotary/ODEX Drilling Fluids Used: Air/water

Purpose of Hole: GGroundwater Monitoring Well

Torget Aquifor: First Water Hole Diamotor (in): 4 Total Depth Drilled (ft): 70

WELL COMPLETION DESCRIPTION Y/N Well Installed? 4" Steel Surface Casing Used?

2-inch, flush threaded, Sch 40, PVC

0.020-inch slot, Sch 40 PVC

Sand Pack? 10-20 silica sand Annular Seal? Bentonite Chips Surface Seal?

Coment

50-70 48-70 0.5-48

0.0.5

DEVELOPMENT/SAMPLING

Screen/Perforations?

Well Developed? Bailer/pump

Water Samples Taken? N

Boring Samples Taken? Y lithologic identification

Northing: 8376.8165 Easting: 7262.8426

Static Water Level Below MP: 56.90

Date: 11/2/06

MP Description: Top of Steel Casing

MP Height Above or Below Ground (ft): 2.77

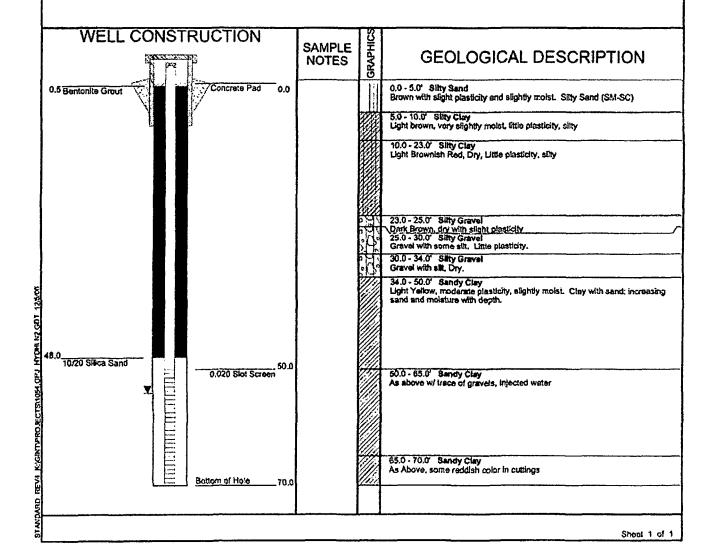
Surface Casing Height (ft): 2.77

Riser Height (ft): 1.83

Ground Surface Elevation (ft): 3958.95

MP Elevation (ft): 3961.72

Remarks:



# Hydrometrics, Inc. Consulting Scientists and Engineers

Helena, Montana

Monitoring well

Hole Name: MW-10

Date Hole Started: 9/27/08 Date Hole Finished: 9/28/08

Client: ASARCO, INC.

Project: Interim Measures East Helena Facility County: Lewis and Clark State: Montana

Property Owner: Aserco Inc.

Legal Description: Sec 36 T10N, R3W

Location Description:

Recorded By: John Bergin Drilling Company: Boland Drilling

Driller: Rick & Chuck

Drilling Method: Air Rotary/ODEX Drilling Fluids Used: Air/water

Purpose of Hole: Groundwater monitoring well

Target Aquifer: First Water Hole Diameter (in): 4 Total Depth Drilled (ft): 70

Screen/Perforations? Sand Pack?

WELL COMPLETION

Well installed?

Annular Seal?

Surface Seal?

Well Daveloped?

Surface Casing Used? 4" Steci Y 0.020-inch slot, Sch 40 PVC

10-20 silica sand Bentonite Chips Cement

**DEVELOPMENT/SAMPLING** Bailer/pump

DESCRIPTION

2-inch, flush threaded, Sch 40, PVC

Water Samples Taken? N Boring Samples Taken? Y lithologic identification

Northing: 8974.659 Static Water Level Below MP: 38.24

Date: 11/3/06

MP Description: Top of Steet Casing

MP Height Above or Below Ground (ft): 2.86

+1.86-62 +2.86-2.14 42-62

INTERVAL

40 - 70 0.5-40

0-0.5

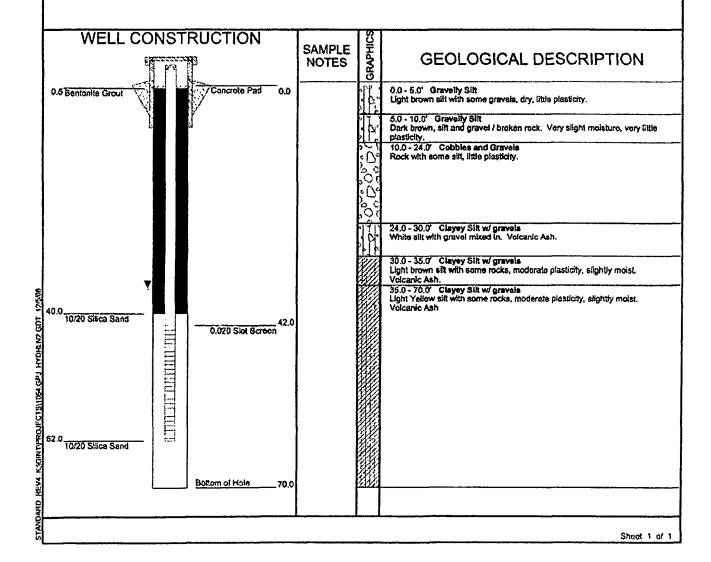
Easting: 7811.757

Surface Casing Height (fl): 2.86 Riser Height (ft): 1.86

Ground Surface Elevation (ft): 3939.74

MP Elevation (ft): 3942.6

Remarks:



### ATTACHMENT B

#### MONITORING WELL INSPECTION FORM

# Asarco East Helena CAMU Groundwater Monitoring Well Inspection Form

	Well ID:	Personnel:		
	Date:	_		•
	Time:	Signature:		
Insp	pection Checklist			
[1]	Protective surface casing in Comments	ntact with locking lid secure?	Yes	No
[2]	Surface seal around outer <u>Comments</u>	casing intact?		
[3]	Positive drainage away fro	m outer casing?		
[4]	PVC well casing and seal ir (e.g., no cracks in PVC, meass Comments	ntact and cap installed? uring point visible, surface seal OK)		
[5]	Evidence of leakage through (e.g., pooled water between Comments	gh lid/protective casing? protective casing and well casing)		
[6]	Total depth measured, con <u>Comments</u>	nsistent with previous results?		
		e required at a minimum frequency of once per	year.	
Adc	litional Comments:			

## ATTACHMENT C

# DATA SUMMARY FOR DETERMINATION OF CONCENTRATION LIMITS

					Parameter			
tationName	Data	Arsenic (As)	Cadmium (Cd)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Manganese (Mn)	Zinc (Zn)
IW-1	Average (M)	0.005	0.001	0.004	0.052	0.005	0.019	0.019
····-	Standard Deviation (S)	0.001	0	0	0.085	0.001	0.005	0.003
	M + 2S	0.008	0.001	0.004	0.223	0.006	0.029	0.025
·	# Non-Detects	5	13	13	10	12	12	13
	# Samples	13	13	13	13	13	13	13
	% Non-Detects	38%	100%	100%	77%	92%	92%	100%
1W-2	Average (M)	0.012	0.001	0.004	0.050	0.005	0.286	0.019
	Standard Deviation (S)	0.003	0	0	0.077	0	0.025	0.003
	M + 2S	0.019	0.001	0.004	0.204	0.005	0.336	0.025
	# Non-Detects	0	14	14	12	14	0	14
	# Samples	14	14	14	14	14	14	14
	% Non-Detects	0%	100%	100%	86%	100%	0%	100%
1W-3	Average (M)	0.011	0.001	0.004	0.027	0.005	0.028	0.019
··· - · · · · · · · · · · · · · · ·	Standard Deviation (S)	0.001	0	0	0.015	0.000	0.004	0.003
	M + 2S	0.013	0.001	0.004	0.058	0.005	0.036	0.025
	# Non-Detects	0.015	13	13	12	13	0.000	13
	# Samples	13	13	13	13	13	13	13
	% Non-Detects	0%	100%	100%	92%	100%	0%	100%
1W-4	Average (M)	0.004	0.001	0.004	0.029	0.016	0.018	0.019
	Standard Deviation (S)	0.001	0	0	0.023	0.038	0.004	0.003
	M + 2S	0.006	0.002	0.004	0.075	0.092	0.026	0.025
	# Non-Detects	9	12	13	11	12	13	13
	# Samples	13	13	13	13	13	13	13
	% Non-Detects	69%	92%	100%	85%	92%	100%	100%
1W-5	Average (M)	0.007	0.001	0.004	0.024	0.005	0.018	0.019
	Standard Deviation (S)	0.001	0.002	0.001	0.010	0.003	0.004	0.003
	M + 2S	0.009	0.001	0.004	0.043	0.005	0.026	0.025
	# Non-Detects	1	13	13	11	13	12	13
· · · · · · · · · · · · · · · · · · ·	# Samples	13	13	13	13	13	13	13
	% Non-Detects	8%	100%	100%	85%	100%	92%	100%
4W-6	Average (M)	0.152	0.001	0.004	0.217	0.005	4.97	0.019
	Standard Deviation (S)	0.051	0	0.004	0.035	0.001	0.289	0.003
	M + 2S	0.254	0.001	0.004	0.287	0.001	5.548	0.026
	# Non-Detects	0.231	9	8	0.207	8	0	9
	# Samples	9	9	9	9	9	9	9
	% Non-Detects	0%	100%	89%	0%	89%	0%	100%
1W-7	Average (M)	0.017	0.001	0.004	0.037	0.005	0.022	0.018
····	Standard Deviation (S)	0.005	0.001	0.004	0.037	0.005	0.022	0.018
· · · · · · · · · · · · · · · · · · ·	M + 2S	0.003	0.001	0.004	0.021	0.005	0.010	0.004
	# Non-Detects	0.027	6	6	3	6	5	6
	# Non-Detects # Samples	6	6	6	6	6	6	6
	% Non-Detects	0%	100%	100%	50%	100%	83%	100%

#### APPENDIX E

OPERATION, MAINTENANCE, AND POST-CLOSURE PLAN

#### **APPENDIX E**

# DESIGN ANALYSIS REPORT ASARCO EAST HELENA CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) OPERATION, MAINTENANCE, AND POST-CLOSURE PLAN

Prepared for:

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Prepared by:

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## TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF ATTACHMENTS	iii
1.0 GENERAL INFORMATION	1-1
1.1 PURPOSE	1-1
1.2 RESPONSIBILITY	1-2
1.3 OPERATING LOG	1-2
1.4 PUBLIC SAFETY AND HEALTH	1-3
2.0 CONSTRUCTION INFORMATION	2-1
2.1 SURVEYING AND RECORDKEEPING	2-2
2.2 CLOSURE PLAN	2-2
2.2.1 Closure Activities	2-2
2.2.2 Closure Schedule	2-3
2.2.3 Notification of Partial Closure and Final Closure	2-3
2.2.4 Survey Plat	2-3
3.0 SITE MONITORING AND INSPECTION	3-1
3.1 SITE INSPECTIONS – OPERATION	3-1
3.2 GROUNDWATER MONITORING	3-1
3.3 LEACHATE COLLECTION AND LEAK DETECTION S	SYSTEM
MONITORING	3-2
3.4 SITE INSPECTION – POST-CLOSURE	3-3
3.4.1 Monthly Informal Inspections	3-3
3.4.2 Semi-Annual Technical Inspections	3-4
3.4.3 Special Inspections After Extreme Events	3-4
3.4.4 Semi-Annual and Special Inspection Procedures	3-4
3.5 CORRECTIVE ACTION FOR IDENTIFIED PROBLEMS	3-6
3.5.1 Response Action Plan	3-7
4.0 SITE MAINTENANCE	4-1
4.1 GENERAL	4-1

	4.1.1 Importance of Maintenance4-1
	4.1.2 Types of Maintenance4-1
•	4.1.3 Maintenance Log
4.2 CA	MU PERMANENT CAP4-4
	4.2.1 Housekeeping4-4
•	4.2.2 Preventive Maintenance
	4.2.3 Corrective Maintenance4-6
4.3 CA	MU TEMPORARY CAP4-7
•	4.3.1 Housekeeping4-7
•	4.3.2 Corrective Maintenance
5.0 POST-CLC	SURE PLAN5-1
5.1 POS	ST-CLOSURE CONTACT5-1
5.2 POS	ST-CLOSURE NOTICES5-1
5.3 POS	ST-CLOSURE LAND USE5-2
5.4 POS	ST-CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE5-2
	LIST OF TABLES
TABLE 4-1.	PRIORITY OF MAINTENANCE TASKS4-2
TABLE 4-2.	EMERGENCY NOTIFICATION
	CONTACTS AND PHONE NUMBERS4-3
	LIST OF ATTACHMENTS
ATTACHMEN	T A INSPECTION FORM AND SITE MAP
ATTACHMEN	

#### APPENDIX E

# DESIGN ANALYSIS REPORT ASARCO EAST HELENA CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) OPERATION, MAINTENANCE, AND POST-CLOSURE PLAN

#### 1.0 GENERAL INFORMATION

This plan addresses care, operation, monitoring, and maintenance of the Corrective Action Management Unit (CAMU) and is included as Appendix E of the Design Analysis Report Asarco East Helena Corrective Action Management Unit (CAMU) Phase 2 Cell. The CAMU is located adjacent to the Asarco East Helena Plant, and south of the community of East Helena, Montana. In 2001 a waste containment facility, known as the CAMU Phase 1 Cell, was constructed for the disposal of soils, sediments and demolition debris resulting primarily from smelter site remedial cleanup activities. In 2007, a second waste containment facility, known as the CAMU Phase 2 Cell, will be constructed adjacent to the Phase 1 Cell, and will contain demolition debris and waste soils from current remedial cleanup activities. Although not required by CAMU regulations, the Phase 1 and Phase 2 Cell were designed to comply with the Resource Conservation and Recovery Act (RCRA), Subtitle C regulations and guidelines.

#### 1.1 PURPOSE

The purpose of this Operation, Maintenance, and Post-Closure Plan is to present guidelines for care, operation, monitoring, and maintenance of the CAMU to fulfill the intent of the remediation activities implemented in response to the implementation of the RCRA Consent Decree (CV98-3-H-CCL). This Operation, Maintenance, and Post-Closure Plan establishes specific criteria and response timelines for repair for each inspection element, including H:\Files\007 ASARCO\6043\R07 CAMU O&M Plan-Rev 4-2007.Doc\HLN\5/3/07\065

notification provisions of required repairs to regulatory agencies. This plan complies with all applicable requirements specified in the Code of Federal Regulations, Title 40, Part 264 – Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264). This Operation, Maintenance, and Post-Closure Plan provides:

- 1. Basic construction information;
- A description of all required site inspection and monitoring activities, including the frequency with which each activity will be performed and the corrective actions that will be taken for each problem encountered;
- 3. A description of all required site maintenance activities, including the frequency with which each activity will be performed;
- 4. Contact information during the post-closure period;
- 5. A description of the planned land uses during the post-closure care period; and
- 6. Financial assurance during the post-closure period.

In addition, this plan minimizes the need for facility maintenance after the site is closed and controls, minimizes, or eliminates to the extent necessary protection of human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground, surface waters, or atmosphere.

#### 1.2 RESPONSIBILITY

Asarco LLC is responsible for implementation of this plan. Asarco LLC is referred to as the owner/operator throughout this plan.

#### 1.3 OPERATING LOG

Asarco LLC will maintain an operating record of all site inspections and maintenance activities as required under 40 CFR 264.73.

#### 1.4 PUBLIC SAFETY AND HEALTH

The CAMU Phase 1 Cell has been closed and is secured by fencing. Like the Phase 1 Cell, the Phase 2 Cell will be fenced and kept secured to control public access to the site. Once the Phase 2 Cell has been closed, the site will pose no special public safety or health hazards.

#### 2.0 CONSTRUCTION INFORMATION

The CAMU Phase 2 Cell consists of the following components listed in order from the bottom to the top of the cap:

- 1. Secondary Composite Liner
  - 3-foot compacted clay liner (CCL)
  - Reinforced GCL liner
  - 60-mil Double Sided Textured HDPE flexible membrane liner (FML)
- 2. Leak Detection, Collection, and Removal System
  - Geocomposite Drainage Layer
- 3. Primary Liner
  - 60-mil Double Sided Textured HDPE flexible membrane liner (FML)
- 4. Primary Leachate Collection and Removal (PLCR) System
  - Geocomposite Drainage Layer
- 5. 2-foot Cushion Layer
- 6. Waste
- 7. 12-inch Gas Migration Layer
- 8. Cap Composite Liner
  - Reinforced GCL
  - 40-mil Double Textured HDPE flexible membrane liner
  - Geocomposite
- 9. Surface Water Collection and Removal (SWCR) System
  - 1-foot thick drainage gravel layer
- 10. Cover System
  - 2-feet cover soil
  - 6-inches topsoil and
  - Grass cover.

#### 2.1 SURVEYING AND RECORDKEEPING

The owner/operator will follow surveying and recordkeeping regulations in accordance with 40 CFR 264.309. The owner/operator will establish a permanent surveyed benchmark, which will be placed on the top of the CAMU Phase 2 Cell once the final cap is complete. The owner/operator will also establish a permanent surveyed benchmark, on the top of the CAMU Phase 1 Cell. After the permanent surveyed benchmark is established, the owner/operator will publish a map to be kept on file in the operating record, which includes the exact location and dimensions, including depth of the cell. The owner/operator will also keep a list of the contents of the cell and the approximate location of each hazardous waste type within the cell.

#### 2.2 CLOSURE PLAN

This plan identifies the steps necessary to perform partial and or final closure of the facility at any point during the cells active life. Partial closure will be necessary when the placement of materials is halted for the construction season and the temporary cap is placed over the cell. Final closure will be completed when all waste has been placed in the CAMU and the cell is ready for the permanent cover. The CAMU Cell will be closed in accordance with 40 CFR 264.111. The final cell cover has been designed and will be constructed to comply with 40 CFR 264.310.

#### 2.2.1 Closure Activities

Before both partial closure and final closure of the CAMU cell, equipment used for placement of wastes inside the CAMU will be moved at speeds of less than 10 miles per hour to the Asarco East Helena Smelter facility where they will be thoroughly decontaminated at the facility equipment wash station. The haul road used to move contaminated pieces of equipment will be thoroughly swept after transport is complete to ensure that closure meets the closure performance standard. Soils testing will be conducted in soils surrounding the CAMU cell once the final cover has been placed on the cell, to ensure that the closure of the cell meets the closure performance standard. Other activities including groundwater

2-2

monitoring, leachate collection and leak detection monitoring, and run-on and runoff control will be monitored as outlined in Section 3.0 during the closure period.

#### 2.2.2 Closure Schedule

It may take approximately three construction seasons of cleaning and demolition at the Asarco East Helena Smelter facility before all waste is placed in the CAMU Phase 2 Cell and the cell is ready for closure. Upon final receipt of waste to the cell, it should take approximately 90 days to place the final cover.

#### 2.2.3 Notification of Partial Closure and Final Closure

In accordance with 40 CFR 264.112(d), the owner/operator will notify the EPA regional administrator in writing at least 60 days prior to the date on which the cell is expected to begin closure. The closure date must be no later than 30 days after the date on which the cell receives the known final volume of waste, or if there is a reasonable possibility that the cell will receive additional waste, no later than one year after the date on which the cell received the most recent volume of waste. Within 60 days of completion of final closure, the owner/operator will submit to the EPA regional administrator, by registered mail, a certification that the CAMU cell has been closed in accordance with all specifications. The certificate must be signed by the owner/operator and by a qualified Professional Engineer.

#### 2.2.4 Survey Plat

In compliance with 40 CFR 264.116, the owner/operator will submit to the local zoning authority, or authority with jurisdiction over local land use, and to the EPA regional administrator, a survey plat indicating the location and dimensions of the cell with respect to permanently surveyed benchmarks no later than 60 days after completion of final closure. This plat will be prepared by a professional land surveyor. The plat filed will contain a note, prominently displayed, which states the owner's/operator's obligation to restrict disturbance of the cell in accordance with 40 CFR 264 – Subpart G regulations.

#### 3.0 SITE MONITORING AND INSPECTION

Quarterly monitoring of groundwater quality and semi-annual site inspections will ensure that public health and safety are maintained at the site. Monitoring and inspection protocol are in accordance with 40 CFR 264.303.

#### 3.1 SITE INSPECTIONS – OPERATION

While the landfill is in operation, it must be inspected weekly and after significant storms to detect evidence of any deterioration, malfunctions, or improper operation of run-on and runoff control systems, and the proper functioning of or presence of liquids in the leachate collection and leak detection system. When in use, the temporary liner cover that is used between construction seasons prior to permanent closure of the Phase 2 Cell will be examined for signs of damage and seam separation. Anchor trenches around the perimeter of the cover will be inspected for liner pullout. Sandbags will be inspected for proper spacing and damage. The temporary liner that will cap the CAMU Phase 2 Cell between construction seasons will be fenced and kept secured to help ensure the cap is not disturbed by people or large animals. Inspection of the perimeter fence will be included in weekly inspections and any maintenance needed to insure a secure site will be recorded and addressed.

#### 3.2 GROUNDWATER MONITORING

Groundwater monitoring will be accomplished in accordance with Appendix D – Sampling and Monitoring Plan. During quarterly groundwater monitoring events, components of the groundwater monitoring system will be visually inspected to ensure good working order. All inspections will be documented on the Inspection/Repair form included in Appendix D and included in the annual report. If any problems with the groundwater monitoring system are encountered, they will be documented on the Inspection/Repair form and the owner/operator will be notified within 24 hours. The owner/operator is responsible for making sure all repairs are scheduled and completed within 14-calendar days of the inspection. Details of completed repairs will be noted on the Inspection/Repair form. The owner/operator is also

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responsible for reporting any significant issues to the EPA representative verbally within 7-calendar days and in writing within 14-calendar days.

#### 3.3 LEACHATE COLLECTION AND LEAK DETECTION SYSTEM MONITORING

The monitoring and maintenance of the CAMU Phase 2 Cell leachate collection and leak detection system will be conducted in compliance with 40 CFR 264.303. The pump used to remove liquids from the sumps will be capable of removing all but the last two feet of liquids from each sump. Therefore, the Pump Operating Level is defined as two feet of liquids in the sumps, which minimizes the head in the sumps and avoids backup into the drainage layer. The owner/operator will record pre- and post-pumping water levels and the amount of liquids removed from the leachate collection and leak detection system sumps once a week during the active life and closure period. After the final cover is installed, pre- and post-pumping water levels will be recorded and liquids will be removed from the leachate collection and leak detection system sumps monthly. The amount of liquids removed will be recorded on the CAMU inspection form (Attachment A). If the liquid level in the sump stays below the pump operating level for two consecutive months, the amount of liquids in the sumps will be recorded quarterly. If the liquid level in the sump stays below the pump operating level for two consecutive quarters, the amount of liquids in the sumps will be recorded semi-annually. If at any time during the post-closure care period the pump operating level is exceeded at units on quarterly or semi-annual recording schedules, the owner/operator must return to monthly water level recording and liquids removal from each sump until the liquid level again stays below the pump operating level for two consecutive months.

Experience with the CAMU Phase I Cell indicates that it is not possible to establish an Action Leakage Rate within the first five years of the post-closure period. This is due to the fact that it is not possible to determine the volume of leachate removed from leakage through the impounded material from the volume of water that entered the drainage system during construction and was not able to be removed. According to EPA guidance (Survey of Technologies for Monitoring Containment Liners and Covers, 2004) leachate levels generally fall to a negligible level in 10 years or less. Therefore, an Action Removal Rate for the

CAMU Phase 2 Cell will be established as soon as enough removal data is collected within the first 10 years of the post-closure period. Action Leakage Rate and leachate collection volumes will be presented as an average daily flow rate (40 CFR 264.302) in the annual inspection report. Once the Action Leakage Rate is established, the Response Action Plan, outlined in Section 3.5.1, will be followed if the Action Leakage Rate is exceeded.

Until an action leakage rate is established, the owner/operator will insure that the depth of leachate does not exceed 12-inches over the primary and secondary liners, by keeping the depth of the leachate to less than 5-feet in the 4-foot deep sumps of the leachate collection and leak detection systems. If the water level in either vertical standpipe exceeds 5-feet, the sump will be pumped immediately and the Response Action Plan, outlined in Section 3.5.1 will be followed.

#### 3.4 SITE INSPECTION – POST-CLOSURE

Periodic inspections are essential to ensure that the cover systems are performing adequately and to identify problems and provide proper maintenance of cover systems. The inspection program will involve three types of inspections: (1) monthly informal inspections, (2) semi-annual technical inspections, and (3) special inspections after extreme events.

#### 3.4.1 Monthly Informal Inspections

The informal inspections will be a continuing effort by on-site personnel, performed in the course of their normal duties but no less than once a month. Education of new personnel will assure the continued effectiveness of these inspections. These inspections will be documented on the CAMU inspection form (Attachment A) and will be concurrent with pumping of the leachate collection and leak detection systems, unless pumping activities are performed on a quarterly or semi-annual basis.

3-3

#### 3.4.2 Semi-Annual Technical Inspections

Semi-annual site inspections during the post-closure care period will include in-depth inspections of:

- 1. Leachate collection and Leak detection system;
- 2. Final cover system; and
- 3. Stormwater control systems.

A professional engineer familiar with the design and construction of the cover systems will perform every other semi-annual technical inspection. The semi-annual technical inspections will document settling and subsidence, erosion, membrane liner damage, status of the stormwater control system, and the cap's vegetative state. The inspection will ensure that the site stays in compliance with 40 CFR 264.280. These inspections will be documented and an annual report will be completed and submitted to the EPA.

#### 3.4.3 Special Inspections After Extreme Events

A professional engineer familiar with the design and construction of the cover systems will also perform Special Inspections after extreme events. The inspection will ensure that the site is in compliance with 40 CFR 264.280. These inspections will be comprehensive and very similar to semi-annual technical inspections and will be performed after extreme events such as rare rain storms, winds, or earthquakes. These inspections will be documented and a Special Inspections report will be completed and submitted to the EPA separate from the annual inspection report.

#### 3.4.4 Semi-Annual and Special Inspection Procedures

The inspection of the cover systems will typically involve walking the entire site in a systematic fashion that ensures the entire site is inspected. A checklist and site map will be used during inspections to aid in the process and are included as Attachment A. The inspection checklists contained in Attachment A, include the following items to be monitored and recorded:

- 1. Settlement or subsidence Inspections will focus on looking for areas of localized settlement, sink holes, ponding water, cracking of cover soils, and any other signs that may indicated cover subsidence. The approximate depth of ponded water or depression, the limits of the affected area, and other pertinent details will be recorded for each inspection. The problem areas will be monitored to determine how the problem develops over time. This will help in evaluating the need for further investigation or repairs and help with planning repair strategies.
- 2. <u>Erosion</u> Any evidence of erosion should be a cause of concern. The inspector will be especially observant along steeper slopes, drainage ditches, areas of vegetative stress, and any areas previously troubled by erosion problems.
- 3. Membrane liner damage Excessive subsidence or vehicle traffic, such as mowing, on the cover may cause damage to the membrane liner. Unless visibly evident, membrane liner damage may be difficult to detect. Any areas on permanent caps where the synthetic materials are exposed will be noted and a repair plan will be developed without delay.
- 4. Stormwater Control System The run-on and runoff stormwater control system needs to be kept clear of all debris. Any evidence of erosion should be noted. The inspector will be especially observant of any subsidence of run-on dikes, the silting or filling in of runoff controls and obstructions that would have the potential to block water flow.
- 5. Cap's Vegetative State Grass or plants with shallow root systems will be selected for the vegetated cover on the permanent caps and burrowing animals will be kept off the site. Areas where grasses are poorly established will be examined to determine the cause of the problem. The inspector will look for signs of excessive wetness or dryness, pest infestations, seepage, rodents, weeds, insufficient depth of topsoil, and other conditions that may inhibit healthy growth of the cover vegetation.
- 6. <u>Perimeter Security</u> The permanent protective caps overlying the CAMU Phase 2 Cell will be fenced and kept secured to help ensure the cap is not disturbed by people or large animals. Inspection of the perimeter fence will be included in the periodic

monthly inspections and any maintenance needed to insure a secure site will be recorded and addressed.

#### 3.5 CORRECTIVE ACTION FOR IDENTIFIED PROBLEMS

If any problem or deficiency is found during any inspection type the following procedures will be followed. The inspector will record the location on a field sketch and will record a complete description of the affected area, including all pertinent data (i.e., size of the area and other descriptive remarks such as exposed synthetic materials, and odors, etc.) on the appropriate reporting forms. An accurate and detailed description of observed conditions will enable a meaningful comparison of conditions observed at different times. This information has three elements:

- Location The location of any questionable area or condition will be accurately
  described so that the area or condition can be evaluated for changes over time,
  repaired, or reexamined by experts.
- 2. Extent or Area The length, width, and depth or height of any suspected problem area will be measured.
- 3. <u>Descriptive Detail</u> A brief, but detailed description of the anomalous condition will be given.

Photographs are helpful in documenting problems. The owner/operator will keep a photographic log of problems, repairs, and general site conditions. This log will provide valuable information when evaluating the long-term performance of the cover system and when planning repair strategies.

If any problems are encountered during routine inspections, they will be documented on the Inspection/Repair form and the owner/operator will be notified within 24 hours. The owner/operator is responsible for making sure all repairs are scheduled and/or completed within 14-calendar days of the inspection. Details of completed repairs will be noted on the Inspection/Repair form. The owner/operator is also responsible for reporting any significant

issues to the EPA representative verbally within 7-calendar days and in writing within 14-calendar days.

#### 3.5.1 Response Action Plan

The Response Action Plan sets forth the actions to be taken if the action leakage rate has been exceeded or if an action leakage rate has not been established, the depth of leachate does not exceed 12-inches over the primary and secondary liners. The Response Action Plan is in accordance with 40 CFR 264.304. The actions to be taken include:

- Notifying the EPA regional administrator in writing of the exceedance within 7 days of the determination;
- Submitting a preliminary written assessment to the EPA regional administrator within 14 days of the determination, as to the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned;
- Determination to the extent practicable the location, size, and cause of any leak;
- Determine, when CAMU is in operation, whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether or not the unit should be closed; and
- Determine any short-term and longer-term actions to be taken to mitigate or stop any leaks.

Within 30 days after the notification that the action leakage rate or depth of leachate has been exceeded, the results of the analysis specified above, the results of actions taken, and the actions planned must be submitted to the EPA regional administrator. Monthly thereafter, as long as the action leakage rate or depth of leachate is still exceeded, the owner/operator must submit the EPA regional administrator a report summarizing the results of any remedial actions taken and actions planned. To make the leak and or remediation determinations specified above, the owner/operator must assess the source of liquids and amount of liquids by source or document why such assessments are not needed. Assessing the source of liquids and amount of liquids by source includes conducting a fingerprint, hazardous constituent, or Hyfiles\007 ASARCO\6043\R07 CAMU O&M Plan-Rev 4-2007.Doc\HLN\5/3/07\065

other analyses of the liquids in the leak detection system to identify the source of liquids and possible location of any leaks, the hazard and mobility of the liquid, and assessing the seriousness of any leaks in terms of potential for escaping into the environment.

#### 4.0 SITE MAINTENANCE

#### 4.1 GENERAL

This section provides guidelines to aid the CAMU operator in instituting and understanding the need for an effective maintenance program. The objectives of such a maintenance program are to:

- Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;
- 2. Ensure reliability of operation and limit environmental impacts;
- 3. Protect and extend the useful life of the CAMU Cell structure; and
- 4. Ensure public health and safety.

#### 4.1.1 Importance of Maintenance

The CAMU Phase 2 Cell structure represents a substantial investment to protect the public health and environment of the areas surrounding the Asarco East Helena Smelter. One of the important factors to minimizing environmental impacts resulting from the site is a sound maintenance program. A sound maintenance program has the added benefit of identifying problems before they become emergencies.

#### 4.1.2 Types of Maintenance

As shown in Table 4-1, there are four types of maintenance listed by priority rather than by frequency. Table 4-1 is provided as a guide to help put the types of maintenance into proper perspective. The different types of maintenance are also discussed in the following subsections.

4-1

TABLE 4-1. PRIORITY OF MAINTENANCE TASKS

Priority	Type of Maintenance	Description and Example				
1	Emergency	A situation requiring immediate attention (for example, fire, earthquake, or flood).				
2	Preventative	Scheduled inspection and minor repairs carried out during inspection (for example, cleaning of gutters and culverts).				
3	Corrective	Corrective maintenance required as a direct result of scheduled inspection (for example, repair of torn membrane liner).				
4	Housekeeping	Routine housekeeping of buildings and grounds (for example, mowing grass, painting, and general housekeeping).				

- Emergency maintenance Emergencies are situations arising unexpectedly that require
  urgent attention. Often, immediate response must be provided to avert potential serious
  damage. Provisions for emergency repair/damage control activities and an Emergency
  Contacts list will be prepared and kept current with a list of phone numbers for local
  emergency response organizations, lining contractors, and agency and owner
  representatives. Table 4-2 provides a list of Emergency Contacts.
- 2. Preventative maintenance Preventative maintenance is work done to extend the life of equipment and structures. With the exception of routine surveillance and inspections, preventative maintenance tasks will be scheduled in accordance with the recommendations of the material and equipment manufacturers. Scheduled inspection and maintenance of all site facilities will help ensure that potential problems are discovered and corrected before they become serious, as well as providing for the performance of periodically required upkeep. During routine inspections, the property managers will be alerted for any abnormal conditions, which could indicate potential problems.

# TABLE 4-2. EMERGENCY NOTIFICATION CONTACTS AND PHONE NUMBERS

#### **General Emergency Numbers:**

Fire Department 911
Ambulance 911
Police 911

#### **Corporate Resources**

#### **Asarco LLC:**

Jon Nickel (East Helena) (406) 227- 4529

Blaine Cox (East Helena) (406) 227-4098

#### Other Resources:

 Hydrometrics, Inc.
 (Helena)
 (406) 443-4150

 U.S. EPA (24-hour emergency)
 (206) 553-1263

 Superfund/RCRA Hotline
 (800) 424-9346

- 3. <u>Corrective maintenance</u> Corrective maintenance is the work required for repairs and other non-routine maintenance. The CAMU owner/operator will handle these tasks as the need arises. Corrective maintenance procedures will follow the equipment or material manufacturer's recommendations. In planning for the corrective maintenance, the CAMU owner/operator will arrange for advice or assistance from an engineer or manufacturer's representative.
- 4. Housekeeping Maintaining well-kept site closure facilities indicate pride on the part of the CAMU owner/operator and cultivates good neighbor relations with adjacent property owners. Housekeeping tasks include mowing grass on the CAMU cap and surrounding areas, controlling weeds, sweeping pavement surfaces, and collecting/disposing of litter or debris.

#### 4.1.3 Maintenance Log

A maintenance log will be maintained by the owner/operator as part of the CAMU Operations Record.

#### 4.2 CAMU PERMANENT CAP

On-site maintenance items are generally limited to grounds keeping tasks since no mechanical systems are provided. Drainage courses, structures, and cover liner integrity are the primary focus of scheduled inspection and preventative maintenance. Periodic inspection of other features, such as above-ground portions of monitoring wells and gas extraction vents is required as part of the informal monthly inspections.

#### 4.2.1 Housekeeping

1. Grass cutting - Periodic cutting will help to establish and maintain a healthy, vigorous stand of grass. This will help control weeds and pests, reduce the potential for grass fires, and provide better erosion protection. In most settings, grass is cut to 4 to 6 inches in height and allowed to grow to a maximum height of 10 inches, at which time it will be cut by the owner/operator.

- 2. Spot Reseeding It is important to keep a good stand of grasses on all areas of the cap to minimize erosion and to keep weeds and other undesirable plant species from becoming a problem. Spot reseeding should be done in late August and early September for best results, however, seeding in early spring may also be effective. Seeding in the dry summer months will most likely be unsuccessful without supplemental irrigation. Necessary seeding should be carried out at least once per year.
- 3. Nutrient Application It may be necessary to periodically apply nutrients or adjust the acidity of the soil. If vegetative stress is evident, the topsoil may be analyzed to determine what nutrient deficiencies exist. This will prevent over-applying fertilizers. Generally, when required, a slow-release type of fertilizer can be applied in late summer to early fall. The local office of the Natural Resource and Conservation Service or Conservation District, or a local consultant may be contacted for additional information.

#### 4.2.2 Preventive Maintenance

- 1. Weed and Pest Control The key to minimizing necessary weed and pest control is to establish and maintain a good, healthy, dense grass cover. If weeds or pests become a problem, first identify the type of weed or pest and then develop a management strategy, chemical or manual, with the help of the local Natural Resource and Conservation Service or Conservation District or a local consultant. Make sure to choose a method that will not affect the integrity of the top liner system. Weed control using chemical herbicides may typically require 1 or 2 applications per year.
- 2. Rodent Control Ground squirrels, field mice, and other burrowing animals may attempt to make their homes in the cover soils. Mounds of loose soil resulting from tunneling animals will encourage weed growth and promote erosion. The mounds should be raked and reseeded. Some burrowing animals could damage the CAMU Cell Cap liners. Appropriate pesticides may be used to control small rodents and burrowing animals. Make sure to choose a method that will not affect the integrity of the top liner system. A significant rodent population may require the advice of a local consultant.

#### 4.2.3 Corrective Maintenance

The following section covers some problems that may be encountered during the post-closure care period. The solutions are by no means all inclusive, but should serve as general guidelines indicating the elements involved for fixing typical case conditions.

- 1. <u>Subsidence</u> When an area experiences excessive localized settlement, the cover may no longer drain properly. Even so, there may not be a problem unless the area is large, there is continued ponding, or the flexible membrane liner is suspected to have been damaged. The problem may require an investigation to determine the extent of the damaged area and the potential for surface water leaking through the CAMU Cell Cap. If it is determined that a repair must be made, the necessary steps involved are:
  - a. Determine limits of area to be repaired.
  - b. Strip topsoil and stockpile.
  - c. Remove gravel layer (drainage layer) and stockpile.
  - d. Cut and remove geocomposite.
  - e. Cut and remove flexible membrane liner.
  - f. Cut and remove GCL.
  - g. Fill depression and grade for proper drainage.
  - h. Place low permeable soil layer, geosynthetic clay liner, or bentonite.
  - i. Install new flexible membrane liner.
  - j. Test seams to ensure integrity of repair.
  - k. Install drainage net (if present).
  - 1. Replace gravel layer (drainage layer).
  - m. Replace cover soil and topsoil and reseed area.
- 2. Erosion Erosion problems should typically involve a relatively minor repair operation unless the condition is left to develop over time. Minor erosion rills in the topsoil may be filled and the area reseeded. An erosion mat of some type may prevent further erosion while the vegetation is being established. Deeper rills may require a more

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extensive repair, possibly involving silt fencing. Persistent and reoccurring rills can be filled with gravel to allow for a controlled drainage path downslope.

#### 4.3 CAMU TEMPORARY CAP

On-site maintenance items are to include repairs to the liner, seams, and sandbags. Cover liner integrity and anchorage are the primary focus of scheduled inspection and preventative maintenance. Periodic inspection of other features, such as above-ground portions of monitoring wells and storm water controls, will also be required.

#### 4.3.1 Housekeeping

<u>Liner Anchorage</u> – Sandbags or tubes that are used to anchor the flexible membrane liner cap over the CAMU cell may need periodic adjustment to ensure they maintain proper spacing.

#### 4.3.2 Corrective Maintenance

The following section covers some problems that may be encountered prior to permanent closure of the cell by construction of a permanent cap. The solutions are by no means all inclusive, but should serve as general guidelines indicating the elements involved for fixing typical case conditions.

- Subsidence When an area experiences excessive localized settlement, the cover may
  no longer drain properly. Even so, there may not be a problem unless the area is
  large, there is continued ponding, or the flexible membrane liner has been damaged.
  If it is determined that a repair must be made, the necessary steps involved are:
  - a. Determine limits of area to be repaired.
  - b. Remove sandbags or tubes from area.
  - c. Cut and remove flexible membrane liner.
  - d. Fill depression and grade for proper drainage.
  - e. Install and seam new flexible membrane liner.
  - f. Test seams to ensure integrity of repair.
  - g. Replace sandbags or tubes to anchor flexible membrane liner.

- 2. Rips and tears Repair of rips and tears in the liner cap is necessary not only to prevent water from leaking through to the underlying cell but also to prevent wind from getting under the liner. If allowed to get under the liner, high winds may inflate the surface of the flexible membrane cap to a point where sand bags will be dislodged.
- 3. <u>Seam separation</u> Repair of separating or inadequately sealed seams is necessary for the same reasons as repair of rips and tears in the liner. Seams can be temporarily repaired using seaming tape, but should be permanently repaired by hot-air welding or sewing as soon as a liner installer can be called to the site.
- 4. <u>Liner anchorage</u> High winds may cause liner edges to pull out or sandbags or tubes to displace. If this occurs, anchor trenches will be excavated, liner edges reinstalled, and the trench filled and compacted in accordance with the liner installation plans. Sandbags or tubes will be repositioned to provide evenly spaced anchorage on the cap liner.

#### 5.0 POST-CLOSURE PLAN

This Post-Closure Plan identifies the activities that will be carried on after closure of the CAMU Phase 2 Cell and the frequency of these activities. Descriptions of planned monitoring and maintenance activities and frequencies for the post-closure period have already been addressed and comply with 40 CFR 264 – Subpart G regulations.

#### 5.1 POST-CLOSURE CONTACT

Environmental Manager ASARCO East Helena Plant 100 Smelter Road P.O Box 1230 East Helena, Montana 59635 (406) 227- 4529

#### **5.2 POST-CLOSURE NOTICES**

No later than 60 days after certification of closure, the owner/operator will submit to the local zoning authority, or authority with jurisdiction over local land use, and to the EPA regional administrator a record of the type, location, and quantity of waste disposed within the CAMU cell. Within 60 day of certification of closure the owner/operator must:

- 1. Record, in accordance with State law, a notification on the deed to the facility property or on some other instrument which is normally examined during a title search that will in perpetuity notify any potential purchaser of the property that the land has been used to manage hazardous wastes, that its use is restricted under 40 CFR 264 Subpart G regulations, and that the survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the cell have been filed with the local zoning authority, or authority with jurisdiction over local land use, and to the EPA regional administrator.
- Submit a certification, signed by the owner/operator, that records the notation on the deed in accordance with State law, including a copy of the document in which the notation has been placed, to the EPA regional administrator.

#### **5.3 POST-CLOSURE LAND USE**

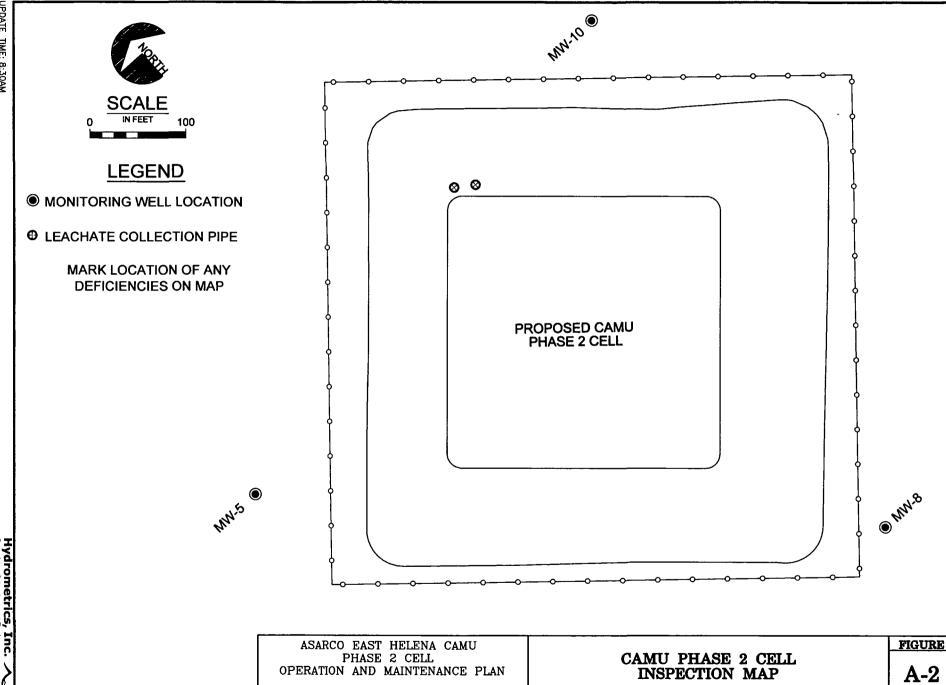
The site of the proposed CAMU Phase 2 Cell will be closed to public access after it is closed. The cell will be fenced to keep out unauthorized personnel and large animals. Limiting access to the site will ensure the integrity of the final cover is kept intact.

#### 5.4 POST-CLOSURE COST ESTIMATE AND FINANCIAL ASSURANCE

The owner/operator has prepared a detailed cost estimate for the post-closure period that includes the annual cost of post-closure monitoring and maintenance of the facility in accordance with post-closure regulations 40 CFR 264.117-264.120. The cost estimate is included in Attachment B. The post-closure cost estimate is in accordance with 40 CFR 264.144. Costs for post-closure care activities are based on the owner/operator hiring a third party to conduct the work. The owner/operator will keep a copy of this post-closure cost estimate at the Asarco facility during the operating life of the facility. Financial assurance for the amount specified on the post-closure cost estimate will be established prior to the receipt of any waste.

## ATTACHMENT A

**SITE MAP & INSPECTION FORMS** 





#### **CAMU INSPECTION CHECKLIST**

ED	Cell N	0.	Inspected by:	Date:		
l E				ACTION NEED		
AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATION	MONITOR	INVESTIGATE	REPAIR
	1	Surface Cracking				
(1)	2	Animal Burrows				
'AC	3	Low Area				
URF	4	Ruts or Puddles				
ER S	5	Vegetation Condition				
UPPER SURFACE	6	Noxious Weeds				
-	7	Settlement/Subsidence				
	8	Erosion				
	1	Slide, Slough, Scarp				
	2	Animal Burrows		<u></u>		
	3	Erosion				
SIDE SLOPE	4	Vegetation Condition				
E ST	5	Noxious Weeds				
SID	6	Exposed Liner				
1	7	Seepage				
	8	Fencing				
l	9	Settlement/Subsidence				
Addition	al Com	ments:		•	+	
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}						

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#### CAMU INSPECTION CHECKLIST

E	Cell No	D.	Inspected by:	Date:		
1 5 1				ACTI	ON NEE	DED
AREA INSPECTED	ITEM NO.	CONDITION	OBSERVATION	MONITOR	INVESTIGATE	REPAIR
	1	Toe Ditches - Obstruction due to vegetation/sedimentation				
ES	2	Toe Ditches - evidence of erosion				
YANG	3	Stormwater Basin - excessive vegetation/sedimentation				
ONVE	4	Stormwater Basin - presence of sand (washout of drainage layer)				
ERC	5	Stormwater Basin - Evidence of erosion or overtopping				
STORM WATER CONVEYANCES	6	Upstream Diversion Ditch-excessive vegetation or sedimentation				
STOR	7	Upstream Diversion Ditch - evidence of erosion				
	8	Upstream Diversion Ditch - evidence of overtopping				
S	1	Condition of Leachate Sumps				
LEACHATE COLLECTION SYSTEM/MONITORING WELLS	2	Leachate Collection Sump-Depth (East pipe)				
E COLI VITORU	3	Leak Detection Sump-Depth (West				
CHAT	,	pipe)				
LEA	4	Monitoring Wells - Condition of Protective Surface Casing				
	5	Monitoring Wells - Presence of Locks				
Addition	al Com	ments:		-		
		<del></del>				

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## ATTACHMENT B

POST-CLOSURE COST ESTIMATE

## Annual Operational and Maintenance Costs for East Helena CAMU Phase 2 Cell

Activity			Hrs	People	Rate *	Times/Year	Total
Mowing of Grass/Weed Abatement				1	\$300 /yr	1	\$300
Monthly Inspections			1	1	\$68 /hr	12	\$816
Semi - Annual Inspection		Inspection and Report			\$3,500 each	2	\$7,000
		Respond to Comments			\$3,500 each	2	\$7,000
Pump Leachate Collection/Leak Detection			4	2	\$68 /hr	12	\$6,528
Well Sampling/Monitoring	Labor						
		Prep	2	1	\$68 /hr	4	\$272
		Sampling	8	2	\$68 /hr	4	\$4,352
		Sample handling/Unload	2	1	\$68 /hr	4	\$544
	Equipment	Grundfos pump & controller		1	\$175 /day	1	\$700
	Leduibilient	Generator	<del></del>	1	\$55 /day	4	\$220
	<del> </del>	YSI multimeter	<del> </del>	<del>                                     </del>	\$70 /day	4	\$280
		Water Tank		1	\$48 /day	4	\$192
		Truck		<u> </u>	\$35 /day	4	\$140
	Analytical		<u> </u>	6	\$250 each	4	\$6,000
* Outside contractor rates were used to cal						Grand Total	\$34,344

Financial Assurance

Applying a 30 Year Good Accounting Practices for Financial Assurance

\$1,030,320

Revised: May 1, 2007

## **TARGET SHEET**

# EPA REGION VIII SUPERFUND DOCUMENT MANAGEMENT SYSTEM

DOCUMENT NUMBER: 1059408

	2.00	
SI	TE NAME:	EAST HELENA NPL (OU2-RV1 RESIDENTIAL), EAST HELENA RCRA CORRECTIVE ACTION
D	OCUMENT DATE:	01/01/2007
Di	ue to one of the fol	DOCUMENT NOT SCANNED lowing reasons:
	PHOTOGRAPHS	
	3-DIMENSIONAL	
	OVERSIZED	
<b>7</b>	AUDIO/VISUAL	
	PERMANENTLY E	BOUND DOCUMENTS
	POOR LEGIBILIT	<b>Y</b>
	OTHER	
	NOT AVAILABLE	
		MENTS NOT TO BE SCANNED Data Validation, Sampling Data, CBI, Chain of Custody
DO	OCUMENT DESCR	IPTION:
		NALYSIS REPORT ASARCO EAST HELENA - TION MANAGEMENT UNIT (CAMU) PHASE 2 CELL